The New England Water-Works Association

Specially Reported for ENGINEERING NEWS.

The Fifth Annual Meeting of this flourishing Association was called to order at 4 P. M., on the 16th inst., in the hall of Acushnet Lodge, I. O. O. F., New Bedford, Mass., by President R. C. P. Coggeshall, Superintendent of Water-Works of that city. Mayor Roteh, was introduced and addressed the Convention as follows:

Gentlemen of the New England Water-Works Association:—It gives me great pleasure as chief magistrate of this city to bid you a hearty and cordial welcome, not only as guests worthy of an honorable reception for your own achievements in the various walks of scientific research, but also as guests from whose presence here some special good may come to us. Among the many blessings which in ancient and modern times have come to the world, may perhaps be reckoned as one of the greatest the introduction of water into the large cities and towns, so that all the people, high and low, rich and poor, may be able to use freely this great preserver of the public health. At considerable cost, and certainly with great care and industry on the part of the men who first conceived and executed the plans, we have brought water into our city, and, as you may perhaps be aware, have distributed it more freely and at less cost to the people than has almost any other city or town in the country. Our superintendent, Mr. Coggeshall, will, I doubt not, take great pleasure in showing you all that we have to show, and in making everything appertaining to his charge appear as well as possible.

Now, gentlemen, I do not suppose that you are invested with more than mortal insight, that you can see things which the mortal eye cannot see, or comprehend thing which the mind of man is incapable of comprehending. But I remember well that when a boy I had a strong conviction that if I should chance to stand in the presence of a great physician and he looked at me and said nothing, that my constitution was all right. In other words, I believed that if there was anything the matter with me he would instantly know it, and feel it his duty to tell me so. Now I need hardly say that as the years have gone by, my boyish faith in the great physician has somewhat weakened. But nevertheless, I have a kind of faith, born perhaps of that boyish feeling, that as you go about our city looking at our pumping engines, our reservoirs and our methods of distributing water, if there is anything wrong about them you will certainly see it and feel it to be your duty to tell us of it. Pardon me, gentlemen, then, if in this cordial reception there seems to mingle something of this selfish feeling; but let me assure you that whatever the sequel may be, whether it shall turn out that while you are here you may, like the good physician, feel it to be your duty to approve or disapprove, to censure or to praise, we shall all feel a new sense of security in your coming, and unite in wishing that your visit among us may be so pleasant as to induce you to make many and frequent returns.

In behalf of the association, Mr. Coggeshall thanked the mayor for the cordial welcome and invited the city government and citizens to be present at the exercises which were about to follow.

After the election of new members, a list of which will be given hereafter, President Coggeshall delivered his address, which we give in full as follows:

Gentlemen of the New England Water-Works Association:

By a provision of our constitution it becomes the duty of the President to address this Association at the opening of each annual convention upon matters pertaining to its welfare.

Let us briefly consider the growth of our society. It was in the month of April, 1882, that twenty-one gentlemen, all managers of different water departments, assembled in the city of Boston to consider the wisdom of organizing such a society as we of this Association to-day represent. Although this assemblage was small in numbers yet much enthusiasm was aroused. As the result a committee was appointed to draft a constitution, which was adopted, and the Association was fairly launched into being on the 21st of June, 1882, with a membership of twenty-seven, all active members. The fall meeting of that year was held at Salem, and on assembling at Worcester at the completion of our first year we recorded a total membership of forty-three. Very modest were our ideas then regarding the future growth of our society, for I remember we then thought that number to be a good showing for the first year. Our second field day gathering was at Pawtucket, and the convention at Lowell at the end of our second year found us with a total membership of fifty-seven, forty-eight of this number being active members. During the third year of our existence four meetings were held instead of two, as in previous years, one of these being the memorable convention with the American Water-Works Association at Boston in April of last year. At this time we received large additions to our ranks and at the Springfield convention a year since we recorded a total membership of 124, and of this number eighty-three were active members.

While the past year has not been distinguished by any gathering as brilliant as that with the American Water Works Association which occurred in Boston, April, 1885, yet there have been a larger number of meetings in the name of the Association than in any previous year. The meetings have all been well attended and the interest of the members has been fully maintained. There have been, as you are aware, five meetings exclusive of the annual convention at Springfield last June, the first being the field day gathering at South Framingham, the remainder being the series of informal gatherings at Boston since the first of the present year. The attendance, including members with their invited guests was forty-two, forty, thirty-one, fifty-five and thirty-three respectively. Our total membership, including those just elected is 187, and of this number 137 are active members, and 50 associate members.

The membership of this Association at present probably represents about 40 per cent. of the total number of water departments and companies of New England, and certainly includes most of those of any considerable size. There is every reason to hope that, later, we, shall count the entire list in our fold. This can only be accomplished by proving to them that they, not we, are the losers in being outside our ranks.

Considered as a whole, I think we have good reason to congratulate ourselves on the progress we have made and on the success which has attended our efforts up to the present time, and, as an Association, we should, I think, consider ourselves fairly equipped to do excellent service for the cause in which we are enlisted.

The marked success attendant on the series of informal monthly gatherings which lately occurred would seem to indicate that the continuance of such a series the coming year must result in still greater good. There can be no better way with less loss of time for the different members to become thoroughly acquainted with each other's methods than through the instrumentality of these informal gatherings.

The committee to whom was assigned the work of revising the constitution have, as you are aware, completed their task, and each of you has received the result of their labors in printed form. Their recommendations have the indorsement of the executive committee.

In the report as presented there is one portion to which I would call your attention especially, viz.: Article V. Section 1, and Article VI. Section 4, which provided for the appointment of a Board of Editors who shall prepare for publication the transactions of this Association. Two reasons present themselves for the appointment of such a Board. First, the including of so much of the detail of the discussions necessarily compels the issue of a bulky pamphlet which in itself is expensive. Second, in the discussion which follows the reading of a paper many casual statements are apt to be made without much thought on the part of the speaker. Perhaps some simple question asked, some trifling occurrence mentioned, all very well and highly appropriate at the time the words were spoken but which the speaker would not care to have set down as an expression of his deliberate thought.

I would not have my remarks interpreted as being in any sense a criticism upon the past work of our Secretary. Not being vested with the power in regard to the revision of the stenographer's reports of our meetings he could not do otherwise than he has done.

In considering the future it seems proper to offer a few suggestions at this time. It has occurred to me that it would not be a bad idea to devote the time alloted to informal discussions at one or two of our future gatherings to a recital of errors. Each member would be expected to give an account of some mistake or mishap which had occurred in his practice. It is entirely human to err and we are not apt to say much concerning our failures, yet experience often teaches that more is to be learned by the candid avowal of a mistake and the discussion which such a statement would bring forth than by the relating of something which is a pronounced success. When we consider the good feelings which have always prevailed at our gatherings, it would, I am sure, be a sufficient guarantee of the spirit with which statements of this kind would be received and discussed.

We all agree that the discussions that follow the reading of a paper should be made the most profitable part of the exercises of a society such as ours, I would call your attention to a method already adopted by some organizations. In this method a complete abstract of the subject matter in each paper is drawn off, and sent to each member at least a month previous to the convention. This provides those who desire it with the line of thought which the paper contains, and the member is thus enabled to prepare himself to take part in the discussion previous to its occurrence. If he is so inclined he can then present his discussion in writing.

And this leads me to say that I think it would be well to provide that all papers to be presented to the Annual Convention, should be in the possession of the Secretary at least two months previous to the time of that gathering. This would be necessary in order to carry into effect the previous suggestion, and it would also give your committee a fair chance to provide a good substitute for anyone who should fail to present his paper.

I confess to a fondness for examining results tabulated in graphical form. Any information thus expressed has a greater value to the average worker than if shown in any other way. At a glance one is able to comprehend more, to compare results with a better understanding, to more rapidly analyze the whole subject matter under consideration, than by any other way. The work of to-day is done with a rush. We can hardly spare time to eat and sleep. In order to command a hearing on any subject from the busy people of this age one must place his ideas in terms direct, forcible and concise. Expression made in a graphical form, is conciseness carried to its utmost limit. Many of us will willingly testify to the value of such work as has appeared in our past transactions, such as Mr. Sherman's diagram for ascertaining the duties of pumping engines, our secretary's compilation of information relative to service pipes, and Mr. Noyes' elaborate tabulation of statistics relative to the weights of cast-iron pipe. It would be well if there were more attempts made to give information relative to various subjects in this form.

I wish to add a few words at this time relative to a topic which was considered by you at the last Annual Convention. I refer to the paper prepared and presented by Mr. Billings and myself on "Uniformity in the preparation of the Annual Report." At the time it was presented this scheme seemed to meet with your hearty endorsement and recommendation, yet, of the reports issued the past year the plan has been adopted and carried into effect in the following places only, Burlington, Vt., Woonsocket and Pawtucket, R. I., and Springfield, Newton, Worcester, Holyoke, Taunton and New Bedford, Mass. In some of these places the scheme was most carefully followed, in others the attempt will be found far from satisfactory to those who may wish to compare results in two or more places. I trust the reason so few adopted this plan may be explained by the delay which occurred in the delivery of the transactions in which the instructions and descriptions of the plan were included.

The ENGINEERING NEWS in a recent editorial advocates the passage of a State law compelling all water supply companies to formulate their statistics on a uniform basis. This article presents the following conclusions: "That there is a vast amount of capital invested in water supply companies which is constantly being increased by the addition of new plants or the extension of those already in existence.

"That the relation of a water supply company to the general public is of the most intimate character and in consequence all classes are thoroughly interested in their welfare and should know something as to their internal management.

"That a large number of corporations such as railroads, banks, insurance, manufacturing, are required by law to make an exhibit which shall be accessible to all desiring such information.

"And the query arises why the law is not extended to include corporations supplying so essential a necessity as water."

Not only would such a law be of service in aiding us to obtain a statement of the actual condition of affairs in "private companies" but it would compel a systematic statement from many larger places where the reports as presented to-day are altogether too obscure.

In examining the list of summaries which have appeared in the reports of various departments for the past year as before stated, I find none more complete and in full accord with the plan than those from Burlington, Vt.; Woonsocket, R. I.; New London, Conn.; and New Orleans, La., the superintendents of which have given fine examples of what may be easily accomplished by each of us. They apparently have not experienced any particular difficulty in arriving at the desired results, and why should any of us? That it will require extra labor to obtain these facts there is no doubt, but of course each of us expects to do his share. I hope you will not consider me over zealous in this matter but I wish each member would agree, if it is in the range of possibility, to see to it, that this "summary" appears in the very next report which is issued by the department under his charge. Will you not give this your earnest consideration and all agree to give it a fair trial the coming year, so that at our next meeting it will be possible to place before you the comparative statistics of the many departments repre-

sented here to-day? In no other way can we ascertain the merits or defects which the plan may possess.

A matter that has been the cause of considerable care to our Executive Committee in the past has been the selection and assignment of topics for discussion. Not that there is any difficulty in our profession in finding an abundance of topics; on the contrary there are so many that the trouble has been to select those of the greatest interest to the greatest number. The new constitution, if adopted, will provide for the assignment of topics by the Board of Editors and I earnestly recommend that our members freely suggest to them any subject which may occur to them upon which a paper and discussion would be of interest and benefit. In this way I feel that the work of our officers may be lightened and the objects of our Association materially promoted.

And, finally, is there not something to be gained by assembling in gatherings like this aside from the business and the discussions? Is it not well for us to occasionally move outside of the mere routine into which our daily thoughts drive us? Do we not see in every profession how easily we may fall into certain ruts which, although apparently making our work easy, are in reality impediments to scientific progress? Does not the the friction of our own ideas with so many different opinions and practices lead us out of these ruts into the path which a free spirit of investigation requires? My opinion is that in consequence we may be enabled to meet the constantly recurring problems which come to each of us with more enlightened conceptions and broader views. Let us then look back on our past to note as warnings the paths of error in which we all have trod while we push on cheerfully and confidently feeling that the present and the future alike are of the utmost importance to us.

The Reports of Secretary Albert S. Glover, and Treasurer Edwin Darling were submitted. The total receipts of the year were $1940.38 which includes a balance of $281.78 from previous years and disbursements and unpaid bills $1649.89, leaving a balance on hand of $290.39 after all claims are settled, We note in this conection that considerably more than half of the total receipts were derived from advertising in the Transactions.

The Constitution was revised and by-laws amended, Among changes made was an article providing for a board of editors to consist of the president, secretary and editors elected by ballot, who shall supervise publishing the reports and assign topics for discussion. On the question of membership of water commissioners it was decided that they might become active members,or honorary members without fees. All the officers of the Association must reside in New England.

The Committee on "Information Relative to Cast Iron Pipe" asked for further time and for authority to raise funds to pay for experiments, which would show whether thinner pipe might not be adopted, at a saving of iron. Mr. William B. Sherman, of Providence, chairman of the committee, said that probably cities and towns would furnish the funds. A. H. Howland, member of the committee said that the city of Newton had already sent twelve pieces of pipe from two manufacturers to the arsenal at Springfield to be burst, and he wished that pieces of the pipe of other manufacturers might also be tested to learn what must be allowed for imperfection in pipe. The committee also asked for statistics of the power of water hammer. The committee was granted a year's further time and was empowered to address water boards for desired information and data.

Mr. Howland of the committee appointed to report on "Uniform Methods of Classification of Water Rates" said that 1100 circulars had been sent out and 700 reports had been received which had not yet been classified. The field of labor was so large that a commencement only had been made and a great deal would have to be accomplished before a satisfactory report could be made.

One of the principal subjects of study was whether domestic rates should not depend in more measure upon the number of rooms occupied by a family than by a number of fixtures. Further time was granted the committee.

At the evening session, William B. Sherman, for the committee on the "Exchange of Sketches," reported that simple information had been requested of the superintendent of sixty water-works represented, but twenty-three had responded. The report urged submitting plans, as they might suggest features which other superintendents had labored unsuccessfully to introduce. If each member would have 100 blue prints of plans made, the cost would not be over $6.50. By exchange of these reports each member would secure a volume which he could not procure otherwise for hundreds of dollars.

A paper by Geo. A. Ellis, late Superintendent of Water-Works at Springfield, Mass., but now of Racine, Wis., on "The Discharge of Mains as Determined by the Pressure Gauge" was read, but was too technical to admit of immediate discussion.

Discharge of Water Mains as Determined by the Pressure Gauge.*

At the outset, it will be frankly admitted that measurement of the volume of water flowing in a water-main, by means of a pressure gauge, is approximate, and that where possible, weir, pump or meter measurement is to be preferred,

The reasons for this preference are twofold: 1st, the inaccuracy of most gauges within such narrow limits as it is desirable to read them, when short distances are covered and the velocity of flow is slight. 2nd, as the velocity in this case is measured by the loss of head or what is the same, the loss of pressure, a slight difference is noticeable in the results obtained by different experimenters and mathematicians in their attempts to find out the velocity in pipes due to a given length and head.

Before making any practical application of this method, it will be well to ascertain how far these objections govern and to what extent they can be eleminated.

The first is largely a mechanical difficulty. The gauge must be large and delicate enough to read to the nicety required. It must be so adjusted as to be accurate within the same limits. A very common practice is to place a gauge beside one used as a standard, and then if they do not at any point vary more than 1 or 2 pounds, to pronounce them near enough for all practical purposes; but this is not true; for our use they should be simply accurate; and having such gauges, we must read them with the same accuracy, not attempting to read the average of the vibration of the needle, but throttle down the gauge to the point where the thread of water passing the cock is so small that everything like pulsation of the needle will be avoided, and any change of pressure will be shown only by a very slow movement extending over a minute at least. The care and attention given to these details will affect the accuracy of the results more than any difference in the formulæ of experimenters.

The second case is almost the reverse of the formula required, with a given length and head to find the velocity, and as this question of velocity or total discharge of any length and size of main is of great consequence to us in the laying of new mains as well as the measurement of the flow in existing ones, I copy a discussion of formulæ in a paper read by me before the American Water-Works Association in 1883:

[For this paper and discussion we refer the reader to the Transactions of the American Water-Works Association for 1883. The paper is a technical one, very valuable and ought to be studied in full, as it is illustrated with two large diagrams which is not easy of reproduction in our size of page. The Transactions are for sale by J. H. Decker, Secretary of the Association, at Hannibal, Mo. ED. ENGINEERING NEWS.]

We will now make a practical application of these principles to the historic town of Adam† made famous by the complete report of the Transactions of its Water Department for the year 1900. This town is supplied by a reservoir on the mountains on the north through three miles of 16-inch pipe, with 231 feet head at the end of the main line, no portion of which rises high enough to touch the hydraulic grade line, or a line drawn from the surface of the reservoir to the lower end of the main. The village itself is situated in a gentle basin, the office of the Water Department being near the centre of the basin and village. The office gauge is about 23 feet or 10 pounds lower than the end of the 16-inch main, the static pressure being at end of main 100 pounds, at office 110 pounds.

The first question we are asked is, how many gallons of water can a 16-inch main deliver per minute. Its length is 15,840 feet; dividing the pressure at the point of delivery by the length, we find the descent for each 1,000 feet to be 14.583 feet, or 6.313 pounds. Referring to "Flow of Water" page 24, we find these figures come between 4,600 and 4,650 gallons per minute; but as the velocity head is 0.84 foot, and entrance head half as much more, we wish to be on the safe side and will assume 4,600 gallons per minute to be the total capacity.

What head will this volume of water be delivered under?

Answer: None.

What has become of the 100 pounds pressure?

Answer: It has all been used up in bringing to the outlet and delivering that volume of water.

Well, our firemen want at least 90 pounds pressure at the hydrant, how much can be furnished at that pressure?

Answer: As the static pressure at the hydrants will be about 10 pounds more than at the end of the main, owing to difference of elevation, we may assume that we must maintain a pressure of 80 pounds at the main. This will be a loss of 20 pounds. Dividing 20 by 15.840 we obtain a grade for 1,000 feet of 1,262 pounds. Turning to page 22, we find that that loss on a 16-inch pipe amounts to a little over 2,000 gallons per minute.

Now our superintendent wants to know if he cannot sit in his office 3-4 of a mile from the end of the main, and tell by inspecting his pressure gauge approximately how much water is being used.

Not without a little preliminary work. We assumed in starting that there was a little difference in pressure between the end of main and office gauge, of 10 pounds. Now we must ascertain if the consumption on the distribution lines increase this difference. To do this we will place a tested and compared gauge at the end of the supply main and by means of leveling between that and the office gauge, or by reading each simultaneously when no water is flowing, find out their exact static difference, (leveling is preferable for you can never be sure with the gates open that no water is flowing.) We will now observe during the day by simultaneous reading their variations from the exact static difference; it may be that the circulation is so perfect that none will appear; but this is doubtful.

We will now open hydrants in different parts of the village noting the effect on both the office and main pipe gauge, till by repeated experiment we determine their respective losses. Assume we have found that for losses on the main line gauge up to 30 pounds, the office gauge shows one pound more in every five, or 36 pounds loss at the maximum. (it is doubtful if this loss would increase uniformly, but as it would be determined by experiment, it is unnecessary to go into that point.) We are now prepared to estimate in the office the volume flowing. The Superintendent says we have only 99 pounds pressure out of 110, it had run down 11 pounds, that means about 9 pounds at the main. Dividing this by 15,840 he gets 0.568 pounds loss for each 1,000 feet of main. Turning to page 21, he finds this loss to mean a discharge somewhat in excess of 1,325 gallons per minute. While looking at the gauge an alarm of fire is rung in, and in a few minutes the pressure drops to 89 pounds. How much this pressure may be affected locally will depend on the location of the fire, but unless there is good reason to the contrary, consider the loss as affecting the entire center of distribution. We have then, observed loss 21 pounds, actual loss 17 pounds. Dividing by 15,840 loss for each 1,000 feet of main, 1,073, pounds, which on page 22 is shown to equal a discharge of about 1,875 gallons per minute, or subtracting 1,325 it proves that about 550 gallons per minute was thrown upon the fire.

These figures are approximate, but they serve to show some of the facts that the pressure gauge may be made to tell regarding the discharge of water from mains.

The question "Should Plumbers be Licensed?" was discussed without any definite conclusion being arrived at. The plumbers are a law to themselves. "What is the Proper and Equitable Charge for Hydrant Service?" was discussed at further length and to more purpose. Burlington, Vt., paid $8.00 per year for each hydrant. New London paid nothing, which like the fable of the boys and the frogs, it was a good showing for the fire department but bad for the water-works.

Secretary Glover said that in Newton the rate is $20 per hydrant, and it is a separate appropriation. If it formed a part of the fire

---

* Part of a paper by Geo. A. Ellis, C. E., of Racine, Wis., read at the New Bedford Annual Meeting of the New England Water-Works Association.

† The Report of the City of Adam, Mass., Water Department is supposed to be the ideal report of the future and to obtain it the reader must address Albert S. Glover, Secretary of the New England Water-Works Association, at Newton, Mass., with the currency to pay for the Transactions for 1885.

department appropriation, probably it would not be half as much. The payment ought to be more than for the actual use of water, on account of the benefit in insurance rates. He thought $50 would be a fair rate.

Mr. Howland said there is a good deal of extra cost throughout the works on account of hydrant consumption, so as to furnish the maximum of water in emergency in the minimum of time. So there should be more of a charge than enough to cover the cost of the water used and of the hydrant itself.

Frank E. Hall, of Quincy, agreed with other speakers, and said that it is fair to make the hydrant service a separate appropriation from that for the fire department, because it is a general benefit in reducing the rates of insurance.

Willard Kent of Woonsocket said when the works there were owned by a corporation the town paid $32.50 a year for each hydrant.

Mr. Darling of Pawtucket said the average price throughout the country is over $50, but in Pawtucket hydrant service is sold to adjoining towns at $20, which is probably the lowest rate in the country under similar circumstances. Where the towns own the works, the bookkeeping ought to be just as careful as if the money is actually paid. The hydrant ought not to be cheaply rated because it is not used; it is like a fire insurance policy, where we are best satisfied to keep on paying premiums for nothing.

Mr. Billings of Taunton said there is great difference in water rates in different places, and this would prevent any equalization of hydrant rates.

Messrs. Darling and Howland agreed that about $30 per hydrant is right. Mr. Darling said if works are so built that they will do good fire duty, they will be popular.

On the Question "Ought an application for Water Supply to be refused, and the application be nevertheless holden for a Water Tax?" Mr. Edward W. Cate of Newton thought that to a reasonable extent the law might hold that a city is obliged to furnish water where the citizens are taxed toward the support of the water department. This is the tendency, but there is no decision yet on the point. A reasonable requirement would be that the applications should pay interest on the cost of extension.

Mr. Billings said he could confirm this to some extent from his experience in Taunton. A two mile main was being laid extending to a sparsely settled locality based upon the idea expressed by Mr. Cate.

Mr. Darling said he had urged making extensions in accordance with this principle.

Mr. Howland said it had been his experience that such extensions paid better per mileage than other sections of pipe.

Mr. Holden of Lowell said that in his city water takers were required to pay interest at the rate of 6 per cent. on the cost of laying mains over 125 feet from its terminus.

Mr. Coggeshall said that was the policy employed by the city of New Bedford.

The proceedings of the second day opened with a visit to the New Bedford Water Works work shop. Everything in and about the premises was in neat and excellent order and condition. Supplies of all kinds for water works uses were there in abundance. Hydrants, valves large and small, pipe connections of a wonderful variety of shapes, service boxes, meters, etc. etc., with the machinery, and appliances for repairing and testing: also a portable tool house, a most ingenious and comprehensive structure on wheels, designed by Superintendent Coggeshall for transporting all the essentials for pipe laying, including even a well secured locker for the workmen's dinners. If plumbers could only see this contrivance and improve by the suggestion, there would be less "diligent waiting" in kitchens and cellars for the inevitable boy who "has gone to the shop" for more tools or pipe. We hope sometime to publish a section of this comprehensive tool chest on wheels. A new plan of iron tubing over service boxes made in two sections so that the top may be lifted by frost without disturbing the bottom was shown. The Howes felt filter and the Hoyt carbon filter were on exhibition.

At 10.30 A. M. the Convention was called to order by President Coggeshall. The Committee on Nominations presented the following for election as officers for the ensuing year, all of whom were unanimously elected:

President—H. W. Rogers, Lawrence.
Vice Presidents—J. C. Broatch, Middletown, Ct.; F. H .Parker, Burlington, Vt.; Benjamin S. Babcock, Nashua, N. H.; George P. Wescott, Portland, Maine; Thomas Lovell, Fitchburg; Willard Kent, Woonsocket, R. I.
Secretary—Albert S. Glover, Newton.
Treasurer—Edwin Darling, Pawtucket, R. I.
Editors—R. C. P. Coggeshall, New Bedford; William R. Billings, Taunton.
Executive Committee—The above, with George A. Ellis, Racine, Wis., Walter H. Richards, New London, Ct., and Frank E. Hall, Quincy.
Finance Committee—George E. Batchelder, Worcester; Nathaniel I. Jordan, Auburn, Maine; Walter H. Harding, Cambridge.

"Information Relative to the best Type of Water Power Pumping Machinery," a paper by Col. John T. Fanning, Consulting Engineer, Manchester, N. H., was read by the Secretary. The author reviewed the evolution of the machinery for raising water, from the earliest times up to date. He mentioned with more or less of detail the following appliances: "Pitcher at the Fountain:" Scoop Wheel: Norias: Chain of Pots: Chain Disks: Archimedean Screw: Bellows Pump: Air Vessel attachment: Plunger Pump (1675); Double Acting Pump. (1716); Bucket Plunger Pump: Revolving Pumps—of which he remarks: "The 16th nd 17th centuries gave us several good varieties of the rotary and centrifugal types of Pumps the best principles of which appear in those classes of pumps to-day, The centrifugal type seems not yet to have reached the best possibilities of its class, and its mechanical elements are believed to be worthy of further investigation and experiment."

Motors: *Combination Pump and Motors.*—Glancing over the prominent types of pumps and moters enumerated, it was observed that "each was in succession eminently well and probably the best adapted for the purposes and skill of the people who made and used them, and that improvement in type accompanied advance in mechanical skill and civilization. The admirable pieces of mechanism that force water thoughout the arterial system of many New England cities would have confounded the water superintendents of the Phœnician aqueducts, yet the skill of the builders of the Carthaginian conduit remains still unsurpassed in its class of workmanship. The feature that is distinguishing the most recently constructed hydraulic pumping machines from those of a decade or more ago, is their special adaptation to direct pressure pumping, whether or not intended to pump ordinarily to a reservoir or tank stand pipe. In Col. Fanning's opinion the turbine wheel and double acting plunger pump, in the present state of mechanics, is undoubtedly the best combination for direct pumping in localities where reliable water power is obtainable. The combination may be reduced to the utmost simplicity of mechanism while retaining the maximum of efficiency, and can respond with almost instantaneous promptness to a required increase of pressure in the water mains, and adapt their motions with great efficiency to variations of draft of water. These qualities are very valuable in a public water-works pumping machine."

The question "What is the Best Form for Service Box at Street Curbing?" was briefly discussed, and an earthenware service box manufactured at Akron, O., was exhibited, after which a paper on "Rainfall; The Amount Available for Water Supply," by Desmond Fitzgerald, Superintendent Western Division, Boston, Mass., was read by the author, who has, by many years of study and diligent observation, acquired the reputation of being perhaps the best authority in the country on matters connected with the collection of water for a public supply, and the laws relating to evaporation. Mr. Fitzgerald accompanied his written paper with a running extemporaneous commentary which could be taken down only by the stenographer for incorporation in the future published transactions.

A map of the United States was exhibited showing the amount of rainfall in different parts of the country. Most of the rainfall in the eastern part of the country comes from evaporation of the Gulf Stream, where the water is almost constantly at a temperature of eighty degrees. In this region, 1880 and 1883 were very dry years. The winter here has less rainfall than other seasons. In 1846, it was very dry, eastern Massachusetts having less than 30 inches of rainfall. In 1882 and 1885 it was even drier, and 28 inches may be the minimum. Evaporation varies from .9 of an inch in January to 6.28 inches in July, about 35 inches in the whole year. With a mean rainfall of 46 to 48 inches, this shows why so little water gets into the rivers in the summer. The trouble with water-works in many places is that they are based on the average instead of the minimum supply. In 1880 and 1883, only about 33 per cent. of the rainfall in the Sudbury water-shed found its way to the river. Sometimes in July, August, September and October not more than 5½ per cent. of the rainfall is available.

Mr. Richards of New London asked why sometimes a rainfall of an inch does not raise the surface of the lake an inch.

Mr. Fitzgerald said it must be laid to evaporation, which is sometimes .6 of an inch in a day. Sometimes there is evaporation when rain is falling.

Mr. W. B. Sherman suggested that the rainfall of an inch at the gauge perhaps did not extend all over the lake.

Mr. Fitzgerald said a rain gauge should have a wide, free exposure in all directions. A gauge elevated 20 feet will catch 10 per cent. less water. One foot is the usual distance adopted by observers. He would prefer 2½ feet.

Phinehas Ball of Worcester thought Mr. Fitzgerald's observations are the most valuable ever made in New England. Mr. Ball had once collected 48 per cent. of the rainfall on a small watershed through the summer. He thought vegetation absorbs a good deal of summer rainfall. Ample storage reservoirs are a desideratum.

Mr. Fitzgerald said 48 per cent. is about the available mean, but he insisted that calculations must be made from the minimum.

Mr. Stacy of Marlborough said his pond is fed principally by springs, and it rises and falls pretty regularly without much reference to the amount drawn off. His pond is on high land, and he thought the springs are of distant origin.

Mr. Tidd of Boston thought that in a rain there is more or less of condensation at low elevations, which would account for the in-

creased rainfall recorded by a gauge at the surface.

During the noon hour the convention adjourned to Library square, where steam fire engines, Progress and Cornelius Howland, were waiting to show the working of Acushnet water in the fire department. They exercised about three-quarters of an hour. Each company laid two lines of hose of 100 feet each and the four lines were coupled to a union pipe. First with a 2-inch nozzle and only hydrant pressure, the water running through the engine pumps, the stream was played 84 feet 9 inches. Steam was got up and the stream was forced to a distance of 216 feet 7 inches. A 2½ inch stream was played 198 feet 1 inch and a stream of 1¾ inches was played to the distance of 253 feet 10 inches from the pipe.

At the opening of the afternoon session at 2.45 P. M., the blue print sketches of special work, contributed by the members, were distributed. The sets contained the following: Edwin Darling, Pawtucket, diagram of daily consumption of water for eleven months; John C. Chase, Wilmington, N. C., table of meter tests; W. B. Sherman, Providence, foundation on quicksand; S. E. Grannis, New Haven, composite pipe; A. B. Drake, New Bedford, weir; W. H. Richards, New London, section of dam, showing action of anchor ice; R. C. P. Coggeshall, New Bedford, details of portable tool-house, two sheets; Frank E. Hall, Quincy, method of tapping wrought-iron pipe, two sheets; Jonas M. Clark, Northampton, general plan of works and a number of devices in connection with street work; Nathaniel Dennett, Somerville, general plan of works; Edward H. Phipps, New Haven, dam built for West Haven Water Co.; D. W. Horan, Clinton, break in 12-inch main in ledge; William R. Billings, Taunton, main pipe plugs.

We wish here to state that this distribution of blue print sketches of work is a special feature of this Association. It is the result of persistent effort on the part of W. B. Sherman of Providence, R. I,, and there is no doubt as to its great value as an educator. To see these bits of experience and to accumulate them for more leisurely study is of invaluable service to each member, and the plan cannot fail to have an extended growth. A little study will enable any person to produce good blue prints and in a few years a volume of illustrated practical experience is accumulated, which in no other way was possible to obtain. It is to be hoped that a much larger exhibit of blue prints will be made at the next convention.

It was voted to hold the next annual convention at Manchester, N. H.

A paper on the interesting subject of "Water Waste" was read by Dexter Brackett, Assistant City Engineer, Boston, Mass., who said it was a well-established fact that from 33 to 50 per cent. of the water supplied in the larger cities was not used but wasted. Since 1883, by the system employed in Boston, the total saving in the consumption on the Cochituate works is nearly 8,000,000 gallons per day This has been secured by the introduction of water waste meters and a system of inspection. The causes of waste may be classified under the head of defective services and fittings on the premises of the takers, defective city mains and negligent or wilful waste. Public opinion, the speaker was sorry to say, was not with restricting the consumption. It is far easier to obtain an appropriation to increase the supply than to restrict the available supply. The result of the waste protection system in Boston, as has been shown, is highly satisfactory. The system should include house to house inspection, waste detectors, the use of recording meters and the inspection of plumbing. The meter system is not economical and it does not obviate the difficulty of waste from leaking mains or through imperfect plumbing.

In connection with this subject the Secretary read a paper on Water Meters, prepared by Lucian A. Taylor, Constructing Engineer, Boston. The first requisite of a meter is durability and accuracy. He gave the result of experiments with house meters at his home. He believed meters should be applied with discrimination, so that waste may be prevented without affecting the revenue. Either the average of faucet rates were too high, in his opinion, or else meter rates are too low. He believed the largest consumers should be required to employ meters. Inspection should go hand in hand with the meter system.

The discussion of this general subject of water was quite extended.

Mr. Hancock, of Springfield, considered that forty gallons per capita per day, and certainly fifty gallons, was a sufficient allowance. The general introduction of meters will reduce the waste to a minimum. But to meter such cities as New Bedford or Springfield would cost $100,000; the maintenance would cost 10 per cent. and interest was $4,000 so that the yearly expense would be $14,000, and he did not think it could be accomplished for less money. Was the saving of water worth that much? The Deacon Waste Detector was a good thing, but he was an advocate of careful house-to-house inspection. The question is not only how to stop waste of water but how to stop it most cheaply. Many people think that a municipal law to prevent waste cannot be enforced; but we are obliged to keep our sidewalks clean and unobstructed and why cannot a similar law relating to waste of water be maintained. If water-works officials were regularly "backed up" by the citizens, the law could be enforced. The people,—the best people, who pay the taxes—want the waste stopped, and if they will say to the Water Superintendents and Registrars—enforce the law against wilful waste it can be done. Inspect every house; if it cannot be done then put in meters.

Jesse Garrett related the experience of the Water Department of Atlanta, Ga. In consequence of loss of pressure in the pipes a new 20-inch main was about to be laid, and he was interested in furnishing it. But it was ordered that meters should be tried and as a result the lost pressure was restored, the purchase of the new main abandoned and his chances for a sale lost. The detailed account of this matter is published in a late report of the Atlanta Water-Works, which give a complete financial statement thereof. It was remarked by Secretary Glover that the revenue from rates was increased after the introduction of meters.

Mr. William Rotch, who was formerly superintendent and engineer of the Fall River Water-Works where meters had been very largely introduced, said that the discussion of the Water Waste was of recent birth, but that it was growing. The importance of saving was not yet realized; but the supply is yearly diminishing, it is farther away, and it will soon be more difficult to make it "go round." The cities are growing, and the demand for more water will keep pace with the cities. A new main will not supply the want; the supply itself will give out. Something must be done. The people must be educated to an economical use of water. An inspector is needed in every house all the time. A few visits a year will not do, for as soon as the inspector goes away, the waste will again commence. The most water is wasted at night when inspection is impossible. The best inspector is a good meter, the cost and care of which has been very much exaggerated. One or two per cent. of cost to maintain was about right. His own experience in Fall River was most favorable and he believed that even meters of inferior design were better than other proposed systems of checking waste.

Mr. Brackett thought that he had been misunderstood in giving his estimate of the cost of maintenance of meters; his estimate of twelve per cent. included not only interest on cost of plant but the annual wear and tear, and he did not consider it excessive. He would meter the water of large consumers and perhaps twenty per cent. of the other service; but he considered inspection better than meters. It would cost Boston $30,000 by inspection against $200,000 by meter.

Mr. Fitzgerald thought that the prevention of waste must be effected. It was a matter of justice. That water should be as free as air was a fallacy; it cost dollars and cents to pump water and there was no use to increase capacity while waste increased proportionately. There must be a point at which to stop; Boston had been unfortunate in its meter experience, and was not a safe guide; Fall River and Providence could show better records.

Mr. Stacy said that the question was a many sided one. Gravity presupposes waste; pumping costs money. His works at Marlborough were supplied by gravity. When the present supply gives out, a new source must be hunted up by going several miles away at a large expense to the taxpayers. It was enough to make a man's hair stand on end to see the way water is wasted in livery stables and bottling establishments. He didn't think the discussion of methods of checking waste had been commenced any too early. Every locality must decide upon the best system for itself. The pocket is a tender spot and meters touch this spot at once.

Mr. Hall said it had been his experience that the use of meters for domestic purposes increased the expense of collection and decreased the revenue.

Mr. Holden said that 600 water meters had been invented, not over six of which are in use. The best way of testing them, in his opinion, is to put them in connection with the best standard meters on a service where a large quantity of water is used intermittently, and make a comparison by this means.

Mr. Chase thought a weekly inspection would overcome the waste, but he thought this would be a nuisance to which the takers would not submit. He favored either the universal use of water meters or else no meters at all. Where meters are used he thought the departments should purchase them; why should the consumer be taxed for the meter any more than for the hydrants or any other part of the system? and incidentally he said he knew of nothing which was sold so loosely as water. It was like boarding a man by the size of his mouth or his stomach, without regard to the number of meals he was to eat or the number of his family. He believed that meters should be made to register gallons instead of feet. Gravity supply costs as much as pumping on account of extra cost.

Mr. Nevons, of Cambridge, did not believe in meters at all. He was in favor of house-to-house inspection every time. In Cambridge a wonderful saving had been effected by this system; in one year the consumption had been decreased 400,000 gallons per diem. at a cost of less than $100. Educate the people that they shall not waste; the annoyance of inspection was not the bugbear that it was credited as; the inspector should be a man of gentlemanly instincts, a man to be welcomed by the water consumers. He should

be well paid. He had 194 meters on large manufacturers. There are about 100 miles of mains. There is one paid inspector, who is also a registrar, and during about three months of the year he employed an assistant inspector. He had given his personal attention to the night inspections. Every fixture is inspected when the canvasser goes around. He made one full inspection once a year.

Mr. Schleiter was strongly in favor of meters. In Meriden they had effected an increase of yearly revenue from $8,000 to$15,000. It is economy for the cities to use meters; the revenue may be reduced but the cost of new works is saved.

Mr. Hawes believed in meters; there were 2,100 in Fall River and the saving was very great, amounting to twenty-six gallons per capita per diem. He thought that there were as many sides to the question as there were grades of meters. Cambridge was a good place for house-to-house inspection; the people were educated, wealthy, careful, many of them absent a portion of the year; Fall River was a manufacturing city and a good place for meters. He then read the following:

The Water Meter.

(J. B. Laying in San Fracisco Wasp).

I'm a wicked water meter, a Pharisaic water meter,
with a face of white enamel, hard enamel, trimmed with brass;
But I wear the soft expression of a painted Simon Peter looking out into the future like a goldfish through a glass—
Click!

As a patent fa:t-distorter and a shameless storyteller
I can beat a circus-poster or a stable auctioneer;
For I grind such tough narrations in my corner in the cellar you may scrape a Beadle novel from the members of my gear—
Click!

Should the people rise and clamor, loudly clamor for reduction; should the board of supervisors fix the water rates too low,
By a esoteric hammer, most ingenious in construction,
I proceed to raise my figure in opposing rati-o—
Click!

But I rarely, very rarely, need to exercise this power,
for the board and my employers keep the water rates secure.
O, they cuddle close together, just like chickens in a shower, and they yank the mighty dollar from the pockets of the poor—
Click!

When a water main is leaking in the avenue adjacent,
and the company are doubtful whom to saddle with the cost,
I announce to their inspector, with a countenance complacent, that I've swallowed and digested ev'ry gallon that was lost—
Click!

When it happened that the carcass of an infant alligator, plays the mischief with my vitals in its efforts to get through,
I record the strange occurrence on my brass-bound indicator by the fraudulent addition of a hundred feet or two—
Cl-l-l-ick!

On the miasmatic matter and the poison which I scatter by the simple name of water, unadulterated pure!
While my friend, the undertaker, waxes richer, slicker, fatter, and the druggist's wife and daughter take a European tour—
Click!

O, I often pause and wonder as I ponder o'er my plunder, pause and wonder why the thunder honest people let me lie,
Why they do not rise in anger, tear me limb from limb asunder and adopt a water meter more ingenuous than I—
Click!

This concluded the discussion when upon motion the thanks of the convention were extended to Chief Macy of the Fire Department for the exhibition of fire streams, and also to the gentlemen who had contributed papers, and to the Committees.

At the Evening Session an invitation was received from the American Water Works Association inviting the New England Association to join it in its annual meeting at Denver, to be held June 23, 24 and 25. The secretary was instructed to forward the regrets of the Association at being unable to accept.

The topic, "How often should Main Valves be Examined?" was then taken up.

Mr. Darling said he made it a practice to examine his valves twice a year, in the spring and in the fall. Several other gentlemen stated that they examined their main valves as often as twice a year, although some did not examine oftener than once. Various methods of packing were also considered.

The next topic was, "What is the Comparative Value of Wiped and Cup Joints?"

Mr. Phillips said there were various kinds of cup joints. Such of these as are made in Taunton he believed were the equal of wiped joints. Mr. Rogers described his method of making cup joints, hydraulic pressure being employed.

The topic, "State the largest water hammer in your experience and the methods adopted in overcoming it."

Mr. Noyes told of cases where air valves and regulators placed upon the pipes had each acted admirably. Messrs. Billings, Hyde, Chase, Tidd, Sherman, Clark, Hall, Darling, Fitzgerald, Horan and others engaged in the discussion, several members told of mains which had been burst and pieces thrown out of the ground by this force.

"Driven Wells" was the next topic.

Mr. Tidd said that the supply in Hyde Park was procured from 64 2-inch wells, from 25 to 38 feet deep. As a test pumping was kept up for seven days, a million gallons being pumped a day, and the second day the vacuum gauge showed 15 feet on the suction. It did not fall below this through the trial, however. The water is pure and nice to drink although a little hard.

Mr. Noyes related a number of experiments which he had made.

On motion of Mr. Billings, the convention, by a rising vote, tendered its thanks to the New Bedford water board and its subordinates for the welcome given.

Mr. Coggeshall responded and introduced Henry W. Rogers of Lawrence, the president elect, who addressed the convention briefly, and an adjournment followed.

According to programme on Friday morning the convention was taken in carriages furnished by the city government, and accompanied by Mayor Rotch and several members of the Council, were driven through the most attractive portions of the city, arriving at 10 A. M. at the distributing reservoir, and a few minutes later at the pumping station, where they were joined by a large delegation from Boston, and adjacent cities having waterworks. Mayors, Water Commissioners and City Engineers were out in force, and all seemed to enjoy the occasion with equal satisfaction. The new Worthington "high duty" pumping engine was as clean and bright as the well appointed and well kept house which covered it, and it worked as quietly and unostentatiously, yet as effectively, as its builders and owners could desire remarks.

The great increase in duty of other types of engines made it an absolute necessity that the efficiency of the always reliable Duplex Worthington should be increased by some device which would still allow it to retain its distinguishing duplex principle which it was not possible to do through the medium of the flywheel. The needed device presented itself, and, perfected by the fertile brain of Mr. C. C. Worthington, who has inherited, with his immense business, a creditable portion of the mechanical ingenuity of his distinguished father, has proved itself eminently successful. Greatly increased economy in the running of the engine has been secured without change in its construction or quality of action.

This improvement marks a most important and radical advance in the position and history of the direct acting engine. It lifts it at once from the plane of a low duty engine to a place alongside of the engines of highest duty on record.

The attachment is shown in the accompanying illustrations. (Pages 406 and 407.)

It consists, briefly, of two small oscillating cylinders attached to an extension of the plunger rod of the engine, preferably beyond the water end. These cylinders and their connecting pipes are filled with water or other liquid. Compressed air from a storage tank is admitted at a suitable pressure to maintain a constant load upon the pistons in the cylinders, through the medium of the interposed water. These pistons act in such a way with respect to the motion of the engine, as to resist its advance at the commencement of the stroke and assist it at the end, the air, meanwhile, exerting its unvarying pressure at each point of the stroke.

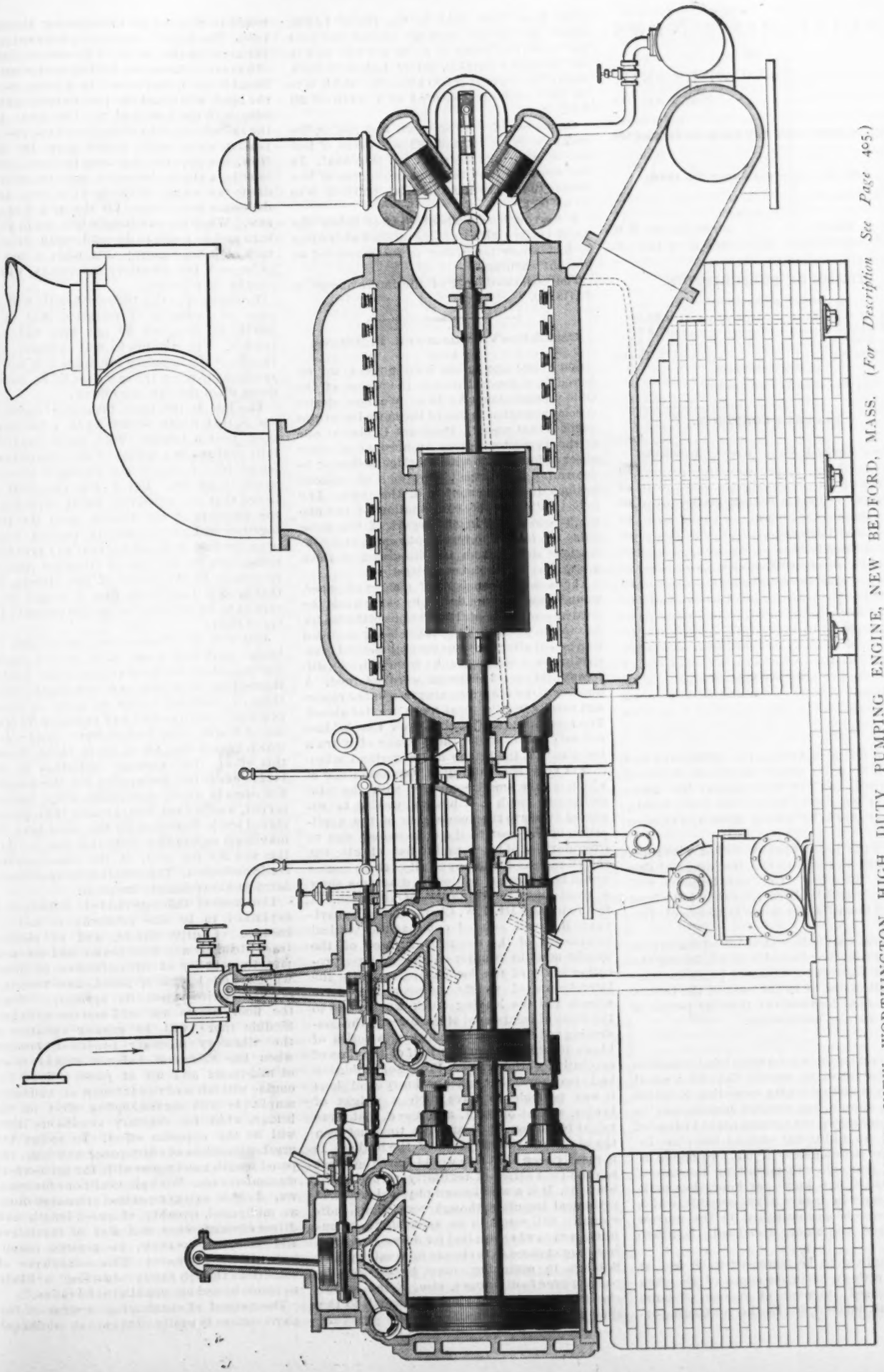
The two cylinders act in concert, and, being placed directly opposite each other, relieve the cross-head to which they are attached, of any sliding frictional resistance, and the engine of any lateral strain.

By thus alternately taking up and exerting power through the difference in the angle at which their force is applied with respect to the line of motion of the plunger rod, these two cylinders in effect, perform the functions of a fly-wheel, but with the important mechanical difference that they utilize the constant pressure of compressed air instead of the energy of momentum. Their action is readily controlled, and their power can not only be exactly proportioned to the work to be overcome, but is entirely unaffected by the speed of the engine. The same amount of expansion can be obtained in the same engine whether running at a piston speed of 10 feet per minute or at 150. This latter feature is one of great importance, affecting as it does so favorably, the economy of the engine when applied on any service where the demand is irregular or intermittent. Where such service is performed by a fly-wheel engine, it is a well-known fact that the best economic results are attained only when the engine is running at nearly its full rated capacity, and that its economy rapidly falls as its speed is decreased. With every change in the rate of rotation of the fly-wheel a corresponding change in the point of cut-off must be made. When the speed is decreased the steam must be made to follow further in the stroke of the piston, thus reducing the expansion, and consequently the efficiency of the engine.

Worthington Engines with this attachment have been fully tested under all the conditions to be met with in actual practice, and have achieved as high a duty as has heretofore been secured by an engine of any other type. A duty of 100,000,000 foot pounds with the consumption of 100 pounds of coal has been considerably exceeded with an engine developing less than one hundred horse power, and with boilers evaporating 10 pounds of water with each pound of coal. The High Duty Attachment can be placed upon any Worthington Engine heretofore constructed, with a resulting increase in the duty of the engine of at least sixty per cent., representing a saving in fuel of about thirty-seven per cent.

(*Continued on page 412.*)

THE WORTHINGTON HIGH DUTY PUMPING ENGINE, NEW BEDFORD, MASS. (*For Description See Page 405.*)



SECTIONAL VIEW WORTHINGTON HIGH DUTY PUMPING ENGINE, NEW BEDFORD, MASS. (*For Description See Page 405.*)

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.
TRIBUNE BUILDING, - NEW YORK CITY.

THE ENGINEERING NEWS PUBLISHING CO. PROPRIETOR.

VOL. XV. Saturday, June 26, 1886.

CONDUCTED BY
GEO. H. FROST, - - - Assoc. Am. Soc. C. E.
D. McN. STAUFFER M.Am.Soc.C.E.; M.Inst.C.E.

TERMS OF SUBSCRIPTION.

TO U. S. AND CANADA.

One Year	$5.00
Six Months	2.50
Three Months	1.50
Single Copies	12 cts.

OTHER COUNTRIES.
Add Postage 3 cents for each number.

TABLE OF CONTENTS.

	PAGE
The New England Water Works Association (*Illustrated*)	401
Editorial Notes	408
Cumulative Vibrations in Railroad Bridges	408
The New England Convention	409
Engineering at Vanderbilt	410
The Immigration Problem	410
American Society of Civil Engineers	411
The Peninsula and Oriental Company	411
Navy Dry Docks	413
Correspondence	413
Foreign Notes	413
Water	414
News of the Week	415
Review of the Iron and Steel Markets	416
Trade Notes	416
Market Report	416

CABLE ROADS IN AUSTRALIA.—Melbourne has decided to have about twenty-six miles of cable road, and the Government has guaranteed 4 per cent. interest on their bonds, which are said to have been taken by a London banker.

They have just let 280,000 feet of wire rope, which was awarded to the Roeblings of this city and Trenton. Our car builders will doubtless build their cars, as they have been building them for the horse railroads of Australia.

It now remains to be seen if our esteemed contemporary on the other side in explaining the failure of English rope makers to get the contract, will claim, as in the case of the twenty New Zealand locomotives, that the people of Victoria are also corruptible.

THE commission to determine what measures should be taken to enable the Suez canal to accommodate a traffic exceeding 10,000,000 tons per annum, has decided unanimously in favor of enlarging the present canal instead of building an additional one, as the plan involves the maintenance of but two banks instead of four and will permit an increase of speed from 5½ to 8 knots per hour, thus making a passage in twelve hours possible, which could never be accomplished in the narrow canals, and the higher speed will facilitate steering.

The depth is to be increased to 28 feet, at present, with an ultimate depth of 29½ when the increased number of vessels of large draft may demand it. In the northern portion, from Port Said to the Bitter Lakes, where the current does not exceed one knot per hour, the width is to be 213 feet and in the southern portion, Bitter Lakes to Suez, where the current is two knots the width is to be 246 feet both measured at a depth of 26½ feet.

On curves of 8,200 or more feet radius, the width is to be 246 and 262 on curves of less radius in the northern part of the canal. In the southern part there are no curves of less radius than 8,200 and the width on them is to be 262 feet.

A narrow berme about 6½ feet below the water surface with its slope pitched with stone 3½ feet above the water, is recommended to prevent washing.

The estimated cost of the improvement is £8,118,600.

Cumulative Vibrations in R. R. Bridges.

Some time ago in our book notices we referred in a general way to the report of the Ohio Commissioner for 1884. We now desire special attention to one of the more important parts of that report. Professor Robinson, one of the inspectors, gives an account of some observations made with a bridge indicator to determine the vertical vibrations of railroad bridges due to the motion of the train. The investigation is the continuation of the one briefly considered in the report of the same office for 1881. The results obtained, and conclusions drawn from the discussion of them are worthy of careful consideration.

The indicator consisted of a sheet of paper, wound about a drum driven by clock work, the vertical and horizontal deflections of the bridge due to the passage of the train being recorded by a pencil after the same general method of recording on a chronograph; from thirteen different bridges 193 diagrams were obtained. A number of the diagrams are given in the report and results from several more are tabulated. The results unquestionably show that bridges not only deflect under the passage of a train but also that the bridge has a vertical vibration of very short duration, the amplitude of which is very small compared with the total deflection. Such a vibration was to be expected owing to the suddenness of the application of the load, to the concussions due to irregularities of track, and to flat wheels; but the vibrations due to any or all of these causes would be irregular, while the diagrams show a persistency to regularity of vibration. A few years ago Mr. J.W. Cloud, of the Pennsylvania Railroad, pointed out that the vertical component of the centrifugal force of the weight used to counter-balance the reciprocating parts of the locomotive, and also the interchange of weight between the drive wheels and the leading truck wheels due to the vertical component of the force in the connecting rod produced the effect of a series of blows at intervals equal to half of the time of revolution of the driver. Professor Robinson had also shown that under ordinary conditions it was possible to have such a weight of bridge, weight of train, and speed, that there might be unison, at least for a time between the blows and the vibration of the bridge. It is readily seen that this would have the effect to produce a series of regularly recurring vibrations. It is a well-known physical fact that rythmical impulses, though very slight individually, will result in an astonishing cumulative action when applied for a time to a body so circumstanced as to vibrate in equal rhythm. Soldiers in marching, must break step in passing over foot bridges, else, if the bridge should have a time of vibration equal to the time of step, the vibration of the structure would be so great as to endanger the structure. The report cites a very interesting experiment on this point. "Fasten the tip end of a common hand-saw to the top of a table or insert it into a kerf sawed in a post, so that the blade will stand out horizontally and flatwise, with the handle at the free end. Place the saw at rest, tie a thread to a tack and suspend it about eight inches from the hand. Now, dropping the tack upon the saw, near the handle, a slight deflection may be observed, due to the weight of the tack; as soon as the deflection takes place, lift the tack from the saw. When the saw handle has made its return and is ready to descend again drop the tack on it once more; this adds a new impulse and the vibratory movement will be greater than before.

By continuing this the saw handle will soon gain an intensity of vibration that would hardly be expected by one who had never tried it. The amplitude will increase more rapidly if the impulses are applied in both directions, up when the saw goes up as well as down when the saw goes down."

The last is the most favorable condition, and is that which occurs when a locomotive goes over a bridge. With these conditions fully realized in a bridge of any considerable length failure of even the strongest structure would be certain. But it was generally believed that the relatively small variation in the pressure of the drivers upon the track together with the constantly varying weight upon the bridge would prevent any rythmical action between the time of vibration and the recurrence of the blows of the drivers, and that even if it did occur that it would be so rare as to be provided for by the ordinary factor of safety.

Just here the observations made with the bridge indicator come in to correct theory. The records in the handwriting of the bridges themselves, show that such cumulative vibrations of a railroad bridge do occur in actual practice. One hundred and ninety-three transits of trains over bridges were observed, of which twenty-five, about one in eight showed this effect. The average deflection of the bridge under the locomotive, for the twenty-five cases in which cumulative effect was observed, was 18.4 per cent. greater than the observed static deflection for the same load, the maximum superadded deflection due to vibration was 28.6 per cent. of the corresponding static deflection. This result is uncomfortably large and surprisingly frequent.

The cause of this superadded deflection is explained to be due primarily to lack of balance of drive-wheels, and to yielding track-stringers and floor-beams, and secondarily to equality of circumference of drive-wheels and length of panel, and vibration of locomotive upon its springs. "When the floor beams are stiff and the springers flexible there will be greater variation in the vibratory intensity produced, because when the excess of balance strikes down at mid-panel and up at panel points, the engine will fall and rise through an increased amplitude with corresponding effect on the bridge, while for contrary conditions there will be the opposite effect. To secure the greater impulses at every panel of bridge, the panel length must agree with the drive-wheel circumferences. With all conditions favoring, viz.: flexible stringers, excess of balance down at mid-panel, equality of panel-length and driver circumference, and also of revolution and vibration periods, the greatest amplitude will be developed. This coincidence of conditions though rarely occurring is likely to result in serious cumulative vibration."

The method of eliminating several of the above causes is easily obvious; as additional

means of reducing the vibration of the bridge, the report recommends the substitution of sliding plates instead of expansion rollers under the ends of the truss, and also recommends extending the stringers into the embankment to obtain additional friction.

However, the most astonishing thing about the results obtained with the indicator is, that the train itself produces relatively a greater cumulative vibration than the locomotive. Such results were wholly unexpected in connection with the train itself. Of the 193 diagrams taken, eleven, one in eighteen, showed an average cumulative effect 26.4 per cent. greater than the corresponding static effect; the maximum was 50 per cent.

The primary cause of this cumulative vibratory effect is the yielding of stringers and floor-beams, and an agreement of panel and half car lengths; a secondary cause is the vibration of the car upon its springs. "Impulses due to the train will occur with some bridges and with others not, and depend on the circumstances of flexible stringers, and coincidence of panel length with half car length; when these are both satisfied the speed of the train must be a half car for each complete vibration; then as each car has two trucks, and as in a freight train the trucks are not far from uniformly distributed, it follows that when one floor-beam is under a truck, each and every other floor-beam will be under a truck or nearly so; and then with flexible stringers it follows that as the trucks strike the mid-panel they will drop a little by reason of the yielding springers, and when they reach the floor-beams they will be correspondingly lifted, thus either causing all the cars on the train to fall and rise, or the bridge to rise and fall, or both. Under these circumstances a downward impulse will be imparted to the bridge on each arrival of the trucks at mid-panel; this indeed at each and every panel throughout the length of the bridge. A ten panel bridge will thus receive ten simultaneous impulses at each complete vibration of the bridge, or twenty impulses for each car length of advance of train, or about 800 to 1,000 impulses per train, with cumulative effect. For passenger trains no cumulative dynamic effect has been observed for the train itself, a fact probably due to the discordant relation of panel and car, and to the variation 45 to 60 feet in passenger cars lengths."

The records show that the vibratory motion here referred to is produced by the cars themselves and is not transferred from the engine, but on the other hand under favorable conditions the vibratory motion due to the cars may be transferred from one set of cars to another along a train. From this fact the possibilities of cumulative effect from long trains are seen to be very great, not only as regards duration but also acquired intensity. The conditions most favorable for this transference are uniformity in weight and length of cars and of loading. Even a slight change in these elements seem to produce an appreciative effect in the vibration of the bridge. The possible vibrations by the engine are limited by the length of bridge and those by the train by length of train.

The only practical remedies suggested are building a stiff floor system, and making the panels of the bridge to be in discordant relation to the half car lengths. "If the stringers could be made perfectly rigid, there would be nothing to fear from the cumulative dynamic effect of the train." "As no cumulative vibration was discovered for passenger trains, aside from the engine, we have only to consider the relation of panel lengths which range in length between 29 and 33 feet, then bridge panels should not be very near 15 or 16 feet, nor 7 or 8 feet. Probably 9 to 13 and 17 are the best panel lengths, as comparatively few coincidences occur with lengths between 9 and 13 or 17 and 20. In deciding upon panel lengths of any bridge, the prevailing length of freight cars, coupling to coupling, should be known, then the half car lengths may be compared with the proposed panel lengths."

As we understand it the tendency of American practice is toward longer panels, which as far as cumulative vibration effect is concerned is fortunate. Seven diagrams were taken from a single bridge but no cumulative effect discovered; apparently the only explanation is the discordant panel length of 19½ feet.

It becomes an exceedingly important fact if by varying the length of the panels a few feet, 26 per cent. of the strain upon the bridge can be obviated. It is possible that "cumulative dynamic effect" is the explanation of some hitherto inexplicable bridge disasters. If the above conclusions are true, then under favorable conditions a light train might produce a very much greater effect than a heavier one.

According to the report cumulative vibration occurs either for engine or train every fifth time a train goes over a bridge. This subject presents food for reflection for bridge builders and offers an inviting field for further experiments and observations. It is hoped that the experiments will be repeated with greater refinements and under various conditions of loading and speed.

The report closes with the following suggestion: "It has been customary to allow a diminishing per cent. for impact, it being from 20 to 50 per cent. for short spans, and vanishing at spans of about 150 feet. But the cumulative dynamic effect will vary the opposite way with the span, and be 50 per cent. or more at 150 feet spans, where impact is neglected, from which it would appear that a constant allowance of 50 per cent. at least should be made for all spans, unless the trusses are so designed as to avoid vibration."

The New England Convention.

One of the most rapidly growing interests in the United States is that of Water Works. New works, large and small, and new extensions are recorded in our news columns every week in the year. On January 1st, 1885, there were about 1025 systems of public water supply on the Continent, and there are now probably 1200. The amount of capital invested in supplying the towns having water works with the quantity of the indispensible fluid necessary for domestic use, the extinguishment of fires, the needs of manufacturers, of railroads and shipping, and of large office buildings, runs up into the hundreds of millions of dollars, and the bonded debts of these works have for many years furnished a favorite line of investment securities. A population once in the enjoyment of unlimited water brought to their homes direct, with all the comfort and luxury that the idea implies, has never been known to discontinue its benefits and go back to the use of wells and buckets and the corresponding scant supply. Schemes of water works are based on this fact, and a gradually increasing revenue has always been presupposed. That this does not in some recent instances show this favorable result is due principally to incompetence in the conception and construction of works, in management of operation, or in downright rascality and fraud.

It results naturally that in the operation and administration of this vast interest, a class of men should gradually be formed who made the subject of an economical and efficient water supply their special and earnest study. Such a class are the engineers and superintendents of our numerous present water works. In many of the small towns or villages, the men in charge of the water supply are ordinary engine drivers, deficient in education, and not over well supplied with knowledge of the wonderful machine they are appointed to manage and keep in efficient order.

But the most of the men in charge of water works machinery are skillful engineers or superintendents, the latter in many cases being also a good civil or mechanical engineer, and to whom his engine is a thing almost to love, and whose greatest pride is in keeping it in the most perfect working condition and amid the most cleanly, bright and well ordered surroundings.

As in other branches of business, union has been proved an advantage, so in this—the operating officials of American Water-works have within a few years past formed themselves into a National Association, while a section of the country, for more frequent and local benefits have formed another and an independent association, without prejudice, however, to the larger union, but rather as an active co-worker in a common interest.

The American Water-Works Association, the National Society, is this week holding its Annual Convention at Denver, Col., and we expect the meetings will be as fruitful of good to the members—and general public through them,—as they will be enjoyable. We hope to be able in due time to present our readers with a report of the meeting.

Last week we enjoyed the pleasure of attending the Fifth Annual Meeting of the New England, Society on the 16th, 17th and 18th inst, and elsewhere this week we have given a partial report of the proceedings.

It is quite impossible for a superintendent of water-works to theorize in the advantages of attending a convention such as this while seated comfortably in his office a day's journey distant, or busily engaged in superintending actual work in his department. Reading the published reports in a newspaper or in the transactions of the Society is but a partial substitute for actual attendance. One must meet in person his fellow experts, see what kind of men they are, engage in conversation at the meetings and elsewhere, catch the opinions that never reach the stenographer or newspaper reporter, visit the points of interest, see the numerous appliances on exhibition that are never described in the reports, make the acquaintances of the manufacturers and their agents who are in attendance, enjoy the good fellowship that abounds, and in general obtain the benefits of a delightful "outing" in company with a select band of kindred spirits.

All this, and more, made the Convention at New Bedford a pleasant three days' vacation; the expense was trifling, the benefits immense in comparison; the City Government and Water Commissioners were assiduous in their efforts to entertain the visitors, and they succeeded admirably; while the indefatigable President and Secretary of the Association managed to keep everything in the smoothest of running order—after the example of the excellent machinery at the Pumping Station, under the control of the President, so that nothing was lacking to render the meeting a genuine success, viewed either as an intellectual tournament or a social gathering.

There is a large commercial significence to such a meeting that must not be lost sight of. The property represented at the meeting aggregated about $45,000,000; this alone in the persons of the superintendents, engineers and commissioners having charge of this amount of property, on the good management of which depended the comfort and health of a couple of millions of people, besides property interests of untold value. Besides this a vast

amount of capital was also represented in the persons of manufacturers or their agents, who are members of the Society and liberal contributors to its funds.

The New England Association has already added much valuable information to our stock of knowledge on the subject of Water Supply; the members may very rightly be considered as in the van of their company by reason of of age and general intelligence, and it cannot but result that each year will add to the value of their organization to their members, and through the better education of those so obtained, to the general public which they as a whole, serve well and faithfully.

Engineering at Vanderbilt.

The commencement at Vanderbilt University, Nashville, Tenn., which has just passed, was of particular engineering interest.

It will be remembered that the Vanderbilt School of Engineering, which was founded in 1879 as an adjunct to the Academic Department of the University, and which was the outcome of a special donation from Mr. Wm. H. Vanderbilt, was established from the first on the basis of a five years course of study, four years of which—beginning with freshman year of the first grade colleges—are spent in a general course of engineering study and practice, and the fifth year is devoted to specialized, particular study in one of four distinct courses of study relating to as many distinct branches of the profession, viz: civil, mining, mechanical and topographical engineering, for either of which the degree of Civil Engineer (C. E.) is given, while the completion of the general course of study of four years is recognized by the award of a preliminary degree of Bachelor of Engineering (B. E.) which is rated on a par with the degrees of A. B. and B. S.

It was expected that this extension of the course to five years, — the least consistent with thorough training in the theory and in the application of the theory of engineering to practice—would result in a small number of successful candidates for graduation. This has proved true as only seven men up to the present commencement have been graduated though the annual number of students has averaged about thirty, and while many undergraduates have gone into active work the best results have come from the graduates. Of the seven, one occupies the chair of Engineering in the University of Texas, one is chief engineer of one of the Huntington system of roads in Kentucky and West Virginia. Two are instructors in civil engineering in Vanderbilt University, one is State Inspector of mines for Tennessee, one is a professor in the City High School of Nashville, and one is assistant engineer of the Kentucky Central Railroad.

In view of the standing which the school has thus established for itself,—during what may be called its probationary period—the Board of Trust of the University have at their annual meeting just passed, erected the school into a distinct "Engineering Department" and placed it, in the scheme of organization, on a par with the Academic, Theological, Law, Medical, Dental and Pharmaceutical Departments. Hereafter it will have its complete faculty numbering now eight full professors and twice as many instructors, assistants and experts. Appropriations were also passed which will materially increase the usefulness of the department by engaging additional industries, adding to its instrumental equipment and enlarging the capacity of its instruction shops.

Here as at other institutions offering high grade instruction the ratio of income from tuition to expenses of operation is very small, tuition being but sixty-five dollars per annum, while in the course of Manual Technology the tuition is entirely free. This course running through two years was established in 1884 for the purpose of giving instruction in the subjects most necessary to thoroughly-trained superintendents of constructive operations, and foremen. It may properly be termed an adjunct to the engineering department so intimate is the dependence of successful engineering operations on properly trained foremen and superintendents. The future of this progressive young department of the Southwest is looked forward to with interest growing up as it is in a section of the country of boundless material wealth as yet almost wholly undeveloped.

The Immigration Problem.

Since the reaction which has naturally followed our construction of over 35,000 miles of railroad in the four years ending 1883, there has been a growing feeling that we have had too much immigration and which has been intensified by the unfortunate riots, incited by persons of foreign birth, in Chicago and elsewhere, until some papers are, with more or less boldness, advocating restrictions (which if against non-producers would be unobjectionable) and lately a Pennsylvanian of some prominence made an address to the Pennsylvania State Board of Agriculture who, as reported says among other things:

"The real solution of the labor problem in this country is to determine how high the wages or compensation for labor can go without destroying labor itself. The market price for an article and the compensation to be paid to labor in its production are not, except to a limited extent, fixed by our country alone. In respect to both we are in competition with the markets of the world. A wise adjustment of duties on the products of foreign labor can to a certain extent prevent the reduction of prices in this country to a point ruinous to labor. But the price of labor can reach a point so high as to be beyond the power of tariff duties to overcome the competition with the poorly paid labor of the Old World. In the countries of Europe there are to day 20,000,000 laborers and artisans, producing articles for home consumption, and their daily wages are greatly less than are paid for like labor in this country. It would cost any one of these laborers or artisans to remove from his home in the Old World, to one in the New, not to exceed $40 or $50. For each one that should come there would be room for one less American laborer. The great attraction for emigration to this country has been that it is the land of liberty, home of the oppressed, and asylum of the exile. In addition make it, by undue stimulation, the most attractive country for high wages and short hours of labor, and how long would it be before the labor market would be overstocked from these beehives of industry, beyond the power of legislation or the capacity of consumption to save American labor from the starvation prices of the Old World? To determine the point to which the price of labor in this country can go and not produce such a result is the real solution of the labor problem."

The above is indorsed by the N. Y. *Tribune* as follows.

"Yet higher wages and shorter hours would probably increase that competition to a point which would be ruinous to labor. This is aside from any question of the ability of capital to pay higher rates. Mr. Grow's candid and instructive remarks ought to be read by every workman."

It seems worth while to compare the views expressed above with the figures of our wonderful increase of wealth which though known generally are not often kept for reference. Of the 12,000,000 immigrants with us, about 7,000,000 have entered the country within the past twenty-five years, during that time our population has increased from 30,000,000 to nearly, if not quite, 58,000,000, or, in other words, we have added over 1,000,000 consumers to our population each year. The deposits in State banks in 1860 were 235 and in National banks in 1880 were 873 millions showing no decrease in circulating capital, and during the same period of twenty years our railroad mileage increased from 30,635 to 93,545. In 1860 our exports were to the value of $334,000,000, and imports $354,000,000, and in 1880 they were $836,000,000 and $668,000,000 respectively. Our crops of corn and wheat were on the two dates 1,012,000 and 2,214,010 bushels, while, as an indication of both prosperity and intelligence, our post office receipts were in 1860, $8,518,069, and in 1880, $33,315,479. According to Mr. W. M. Grosvenor, of which the *Tribune* should know, the fall in prices between 1860 and 1885 has been from 100 to 77.66. Wages have risen during the same period 25 per cent. so that a unit of labor would purchase one half more now than then, and this change has been so persistent that none of us are willing to go back to the style of living in vogue 25 years ago. Our production is held to have about kept pace with the increased compensation to labor, having increased, through the perfecting of machinery and the economies that can be introduced in production on a large scale, about 60 per cent. per capita employed. This does not look as if any American laborer had been crowded out or had the reward of his labor lessened, nor has there been any lack of capital for the last two years if we can judge from the prices of securities in this market.; on the contrary, there has been a continuous increase in both floating and fixed capital through the whole period of twenty-five years.

It is not worth while to thresh again the thoroughly pulverized straw of the theory that wages are paid from capital only, for whether they are so paid, or both wages and capital are the products of the profitable employment of labor, there has never been lack of capital to pay laborers' wages where there has been commercial confidence in the value of the laborer's product, and the increasing use of the sliding scale of wages shows that the laborers propose to keep up with the profits.

Assuming that our past industrial history throws light on the future, it seems that the questions of interest to this country and the world, in regard to any part of Mr. Grow's 20,000,000 laborers and artisans are: Can they, coming here, be trusted to demand as high a standard of living as their fellows now here, or in other words will they extend our home market proportionately to their numbers? Considering their proximity to food, raw material and a market, would their labor be more or less productive here or where they are at present?

Would their consumption of food and the raw materials of manufacture, be more advantageous to us with them in this country or where they now live?

Our readers are abundantly able to answer these questions, but it may be mentioned that England (our best foreign customer) took commodities from us last year to the value of $11.87½ per capita of her population, at this rate the 20,000,000 purchase $327½ millions worth from us, while their wages here at $300 per annum would amount to more than our total agricultural exports for the last ten years.

The Duluth & Iron Range Railroad Contract.—The contract has been awarded to J. S. Wolf, of Ottumwa, Ia., the lowest bidder. The cost will be in the neighborhood of $18,000 a mile, the distance being a little over twenty-six miles. A number of fills must be made where there are no cuts or only skimming cuts to correspond. It will be difficult to scrape up dirt for these fills and carting in the rough and tangled country is out of the question. Other bidders were Winston Bros., Geo. F. Fagan & Co., Halverson & Co., E. E. Erickson, Davis & Co., McDonald & Co., Thornton & Shaw, McArthur Bros., LeMay & Co., Dombie & Gray, Starr & Co. According to specifications the track must be ready for trains the entire distance, November 15th.

American Society of Civil Engineers.

Annual Convention of 1886, at Denver, Col.

The general arrangements for the Convention remain as stated in the previous circular. The special train will arrive at Denver early Friday morning. The sessions of the Convention will be held on Friday, Saturday and Monday, July 2d, 3d and 5th. The excursions will be as stated in former circular.

The special train will leave New York, (Grand Central Depot) at 10 A. M. *sharp* on Tuesday, June 29th. It will be run as a second section of the Limited Express, over the New York Central and Hudson River; the Lake Shore and Michigan Southern; and the Chicago, Burlington and Quincy railroads. It will pass the following places a little after the times stated as follows: Albany, (N. Y. C. & H. R. R.) 13.10, Eastern Time, Tuesday; Syracuse, 17.00, Tuesday; Buffalo, 19.45, Central Time, Tuesday: Erie, (L. S. & M. S.) 22.00 Tuesday; Cleveland, 24.25 (Night) Wednesday morning; Toledo, 3.30, Wednesday; Elkhart, 6.50, Wednesday; Chicago, arrive 10.20 Wednesday morning; leave Chicago (C. B. & Q.) 14.00 Wednesday afternoon; Burlington, 21.00, Wednesday; Pacific Junction, 8.25, Thursday; Plattsmouth, 8.50, Thursday; Lincoln, Noon, Thursday; Oxford, 19.20, Thursday; McCook, (arrive) 21.45, Central Time; (leave) 20.55, Mountain Time, Thursday; Denver, 7.00 Friday morning.

A special car will leave St. Louis on Wednesday and be run to Monmouth Junction or Burlington, where it will be attached to the special train; members desiring to take the St. Louis car will please communicate with ROBERT E. MCMATH, M. Am. Soc. C. E., Sewer Commissioner, City Hall, St. Louis.

Sufficient cars to accommodate all who notify the Secretary of their intention to take the train will be provided at New York. An additional car will be attached to the train at Chicago.

The train will consist of sleepers and hotel cars. Meals will be regularly served on the train at 75 cents per meal. The cars are chartered by the Committee for the whole trip. The railroad companies haul the whole train at a fixed rate per mile. No railway tickets or passes will be of service on this train. The committee will provide cards of identification for all entitled to travel upon it.

It will be seen that the cost to each person can be positively determined only when the Committee know the total number of persons. The Committee can now say that the price will be in all probability not to exceed $60 from New York; $50 from Cleveland; $40 from Chicago; $40 from St. Louis. This is to include the transportation on the train to Denver and return and one berth (half a section) in a sleeping-car. A full section for one person will of course involve an extra charge.

Members who desire to join the train at any point, who have not already notified the Secretary, are requested to do so at as early a moment as practicable, either by letter or telegraph.

WILLIAM R. HUTTON, A. M. WELLINGTON,
WILLIAM H. WILEY, R. E. MCMATH,
ROBERT B. STANTON, JOHN BOGART,
Committee.

Address the Secretary, Am. Soc. C. E., 127 East 23d Street, New York.

In addition to papers and discussions already announced, the following will be presented at the Convention:

"The Davis (Crevasse) Levee," S. F. Lewis; "A Novel Application of the Polar Planimeter," Charles E. Emery; "Excessive Rain-Falls," R. L. Hoxie; "The American Line from Vera Cruz to Mexico, with notes on the best methods of surmounting high elevations by rail," A. M. Wellington; "The Negative Values of Distance, Rise and Curvature on Railroads," H. V. Hinckley; "English and American Railroads Compared (Supplementary Paper)" Edward Bates Dorsey; "Building Stones," Alexis A. Julien.

The Peninsular and Oriental Company.

This is the oldest steam mail packet Company in existence. It was incorporated by Royal Charter in 1840, but as early as 1837, when known as the Peninsular Company, it commenced to carry the mails from Falmouth to Lisbon, the principal Peninsular ports, and Gibraltar. This service had been previously performed weekly by sailing packets, wind and weather permitting, and the Lisbon mails were frequently three weeks old on their arrival in England. This period is now more than sufficient for the English mails, via Brindisi, to reach Bombay by the steamers of the Peninsular and Oriental Company. The company's mail contracts now extend to India, China, Japan and Australia, and in the performance of these services their vessels steamed last year 2,482,941 nautical miles, or equal to 100 times round the world. The first steamer owned by the company was the William Fawcett, built in 1829, a little wooden paddle boat 74 feet long, 206 tons. Wood was the material used for the hulls of the company's steamers from 1837 to 1842, when they became possessed of their first iron ocean steam vessel.

From that date iron rapidly superseded the use of wood, and this material in its turn had to yield to steel in 1880, when the company build their first steel vessel. They now possess fourteen vessels measuring 61,477 tons built of this material. In 1837 the steamers were built about five times as long as they were broad; this proportion of length to beam gradually increased to ten to one in 1874, after which the ratio slowly decreased to between eight and nine to one, the present proportions. In the early days of steam navigation the bow of the vessel was made much fuller than the stern. This proving to be an error where speed was a necessity, as in mail services, the company lengthened several of their steamers forward between the years 1844 and 1852, with a satisfactory increase of speed.

A few years later, in 1857-59, as the demand for larger tonnage increased, the company lengthened two of their fine ended vessels amidships, with a marked saving in fuel in proportion to tonnage driven. Several vessels were lengthened amidships at a much later date for special reasons. Safety has always been a special feature in the designs and working of this company's fleet. Their steamers have been divided into watertight compartments for safety since 1840. They are now constructed to meet the Admiralty requirements as armed cruisers and transports, in which important national services they are extensively employed by the Government. The company's earliest vessels, built in 1829-51, were propelled by paddle wheels. They owned their first screw vessel in 1851, from which date they practically ceased building paddle vessels, the screw possessing so many advantages for ocean navigation. The slow moving ponderous paddle engines were displaced by faster moving gear screw engines in 1851, and by very much quicker moving direct acting screw engines in 1855, and since then the speed of the engines has been still further increased. The wasteful jet condenser was superseded by the surface condenser in 1861, when the compound engine was adopted. The superheater was introduced in 1860 with a marked saving in fuel. Up to 1847 the usual steam pressure was seven pounds per square inch, but after that date it slowly rose to twenty pounds in 1855, as improvements were made in the design and manufacture of engines and boilers. Since the introduction of the compound expansive engine into the company's fleet in 1861, the pressure has risen to forty pounds in 1870 and to ninety pounds in 1881, and now it has reached 140 pounds pressure to suit triple expansive engines. The company have at different periods rendered most important public services in the transport of troops under the circumstances of emergency:—In the Ceylon rebellion of 1848; the Crimean war, when something like 62,000 troops and 15,000 horses were conveyed; the Indian mutiny in 1857-8; the Persian war, 1857; the China war, the Burmah war, the Abyssinian war, and various other minor occasions too numerous to mention, and later in the Egyptian campaigns.

Magnitude of the Company's Fleet and Workings.

	1874.	1885.	Increase in 11 years.
Gross tonnage of the fleet	116,295	175,911	59,616
Effective horse power.....	96,637	163,100	66,463
Total nautical miles run	1,635,768	2,482,941	847,173
Gross tons of coal consumed by the fleet only	280,000	421,818	141,818

The above figures show that an increase of tonnage of about 50 per cent. has been propelled 52 per cent. more miles by an increase in coal consumption of only 49 per cent., while there has been an increase of fully 20 per cent. in the average speed. The comparative economy thus demonstrated, is due to the improvements in machinery, and also to a certain extent to a better adaptation of form to the attainment of speed. The fleet, which consisted of two little wooden paddle steamers in 1837, averaging less than 300 tons each, now comprises fifty large iron and steel-screw steamers, measuring 175,911 tons and averaging 3,518 tons each. The magnitude of this fleet may be imagined when it is stated that, if the vessels were ranged in a line one behind the other without any intervening space, they would extend in one unbroken length four miles. During the past twelve years the company have disposed of nearly 60,000 tons, and have added about 140,000 tons, so that the present fleet is almost new. If the company's mail services keep the company's name more constantly before the public than any other branch of its operations, its passenger service is even more important to a large section of the community. The company carried during last year over 40,000 passengers. Fifteen of the newest steamers of the company are fitted with the electric light both for the lighting of saloons, and for cargo purposes, and most of these ships carry refrigerating machines, whereby provisions can be kept good in all weathers, and from which iced water, etc., can at all times be obtained. — *Herapath's Journal.*

EQUALIZATION OF PRICES.—The New York Chamber of Commerce in its annual report takes a forbidding view of the trade situation. Writing of present business tendencies the secretary says:—"Capital controls business to an extent never before known. Moreover it equalizes values." Much more than this is needed to explain the rapid business changes of the day, and the wonderful equalization of prices. The locomotive, the telegraph, and the consequent quick conveyance of the price-making intelligence, are the immediate causes. The spinner at Manchester is now able to order his raw cotton by cable from an interior Texas town. The English manufacturer now sends his agents through the Western States of America. Comparatively moderate price-fluctuations are everywhere taking the place of the sharp ups and downs of former days, and all because man has been able to penetrate the secrets of steam and of electricity. As a consequence the manipulation side of commerce tends to go down, and the production side to take a higher place. The locomotive and its belongings has become the great middleman.—Herapath's *Journal.*

The New Bedford Engine was recently tested and the following is a copy of the preliminary report of the experts:

HENRY R. WORTHINGTON, NEW YORK.

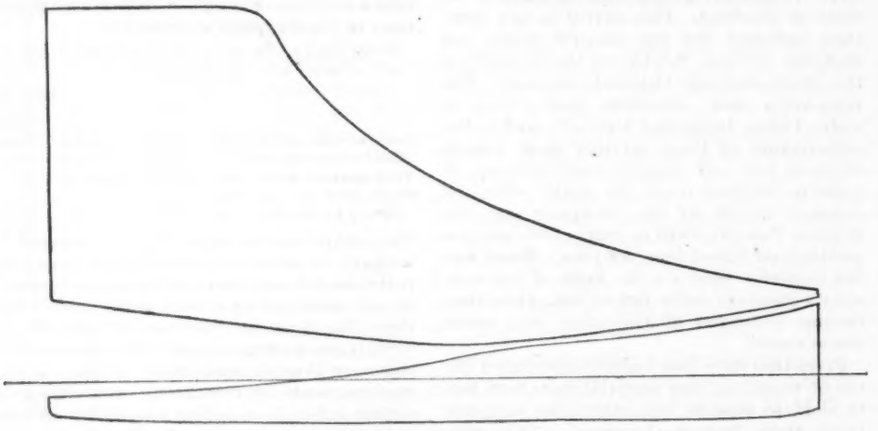
Dear Sir:

The engine recently constructed by you for the New Bedford Water-Works was subjected yesterday to a duty test for the period of twelve hours, in accordance with the requirements of the contract.

The average speed of the plungers was about 94 feet per minute. The average head, including suction, was 137 78-100 feet. The water delivered was ascertained by plunger displacement, and tested also by weir measurement.

The duty as calculated by the requirements of the contract exceeded the guaranteed amount of 100,000,000 foot-pounds. The water-pump, tested by weir measurement, exceeded, 3,000,000 gallons in twelve hours, corresponding to more than 6,000,000 gallons in twenty-four hours.

The engine ran with satisfactory smoothness and regularity, the shortage in the strokes averaging less than 1-100 of 1 per cent.



Steam Card No. 1.

The engine is substantial in construction and the high duty attachment worked very satisfactorily.

[Signed by] { WILLIAM ROTCH, WILLIAM R. BILLINGS, ROBERT P. C. COGGESHALL,

Board of Experts representing the City of New Bedford.

The contract for this engine called for the delivery of 5,000,000 gallons in twenty-four hours. The duty was calculated on actual coal burned under the boilers, and no allowance was made for friction of water through the pumps, nor for losses of heat in the 190 feet of steam pipe which connected the engine with the boiler.

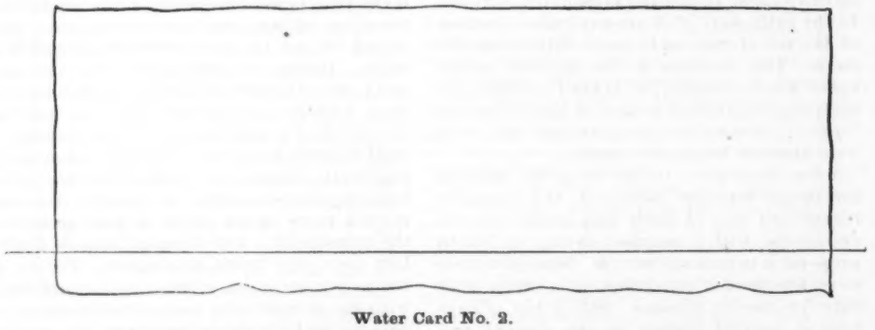
The tests showed that the boilers evaporated only about 8½ pounds of feed water per hour per pound of coal. Had they been of ordinary efficiency the duty would have been correspondingly increased. On the basis of 10 pounds of feed water evaporated per pound of coal, the duty would have been over 118,000,000.

In achieving this result the engine was only developing about 135 horse power.*

The firm of Simpson & Co., who recently arranged to manufacture the Worthington High Duty Engine in England, have secured a number of important contracts.

This engine is attracting universal attention among engineers abroad as well as in this country.

After the pumping engine and house had been thoroughly inspected, the convention was invited to partake of a handsome collation provided by Henry R. Worthington, and spread beneath a spacious tent, on the lawn of the pumping station, after which a special train conveyed them to the steamboat wharf where they embarked on board the steamer *Martha's Vineyard* for a couple of hour's sail on Buzzard's Bay. A fine band furnished good music and another collation was served on board the boat at the expense of the Water Commissioners of the city of New Bedford. The day was a delightful one, and the excursion a most agreeable one in every feature. The return was made in time to take the special train at 3.15 P. M. to Boston and Providence direct from the steamboat landing,



Water Card No. 2.

when this most satisfactory and well managed of conventions came to a close.

* The accompanying water and steam cards were taken from this engine.

MEMBERS PRESENT.

The following members were present:

Active Members.

Willard Kent, superintendent, Woonsocket, R. I.
Edwin Darling, superintendent, Pawtucket, R. I.
Horace G. Holden, superintendent, Lowell, Mass.
H. L. Schleiter, superintendent, Meriden, Conn.
John C. Chase, superintendent, Wilmington, N. C.
Robert C. P. Coggeshall, superintendent, New Bedford.
R. M. Gow, superintendent, Medford.
Albert S. Glover, registrar, Newton.
H. W. Rogers, superintendent, Lawrence.
James H. Hathaway, registrar, New Bedford.
S. E. Grannis, superintendent, New Haven.
J. C. Broatch, superintendent, Middletown, Conn.
N. Dennett, superintendent, Somerville.
William M. Hawes, commissioner, Fall River.
H. B. Winship, engineer, Troy, N. Y.
E. A. Wood, assistant secretary, West Newton, Mass.
Joseph E. Beals, superintendent, Middleboro.
Albert F. Noyes, engineer, Newton.
W. H. Richards, superintendent, New London.
J. C. Hancock, superintendent, Springfield.
Jonas M. Clark, superintendent, Northampton.
William F. Codd, superintendent, Nantucket.
William B. Sherman, engineer, Providence.
Addison Lane, superintendent, Melrose.
William R. Billings, superintendent, Taunton.
A. G. Pease, superintendent, Spencer, Mass.
A. H. Howland, engineer, Boston.
Patrick Kieran, superintendent, Fall River.
F. H. Parker, superintendent, Burlington, Vt.
Edward W. Cate, commissioner, Newton, Mass.
George A. Stacy, superintendent, Marlboro, Mass.
Phinehas Ball, engineer, Worcester, Mass.
A. E. Martin, superintendent, South Framingham.
Hiram Nevons, superintendent, Cambridge.
William S. Barbour, city engineer, Cambridge.
F. F. Forbes, superintendent, Brookline, Mass.
Benjamin S. Grush, superintendent, Salem.
M. M. Tidd, hydraulic engineer, Boston.
David W. Horan, superintendent, Clinton, Mass.
George E. Batchelder, registrar, Worcester.
Frank E. Hall, superintendent, Quincy.
Desmond Fitzgerald, superintendent, W. Div. Boston.
George E. Winslow, superintendent, Waltham.
M. Mason, superintendent, St. Albans, Vt.
Dexter Brackett, assistant engineer, Boston.
H. N. Hyde, Jr., superintendent, Newton.
Albert B. Drake, engineer, New Bedford.
B. F. Drake, superintendent, Laconia and Lake Village, N. H.
R. R. Yates, superintendent, Northboro, Mass.
J. W. Morse, superintendent, Natick.
Wilbur F. Learned, resident engineer, Ashland Basins, Boston Water Works.
J. Henry Brown, superintendent Mystic Division, Boston Water Works.
W. C. Wilcox, ex-water registrar, Waltham, Mass.
John H. Perkins, superintendent, Watertown, Mass.

Associate Members.

John C. Kelley, National Meter Co., New York.
Charles H. Baldwin National Meter Co., Boston.
Jason Giles, Chapman Valve Co., Indian Orchard, Mass.
W. D. Fiske, Knowles Steam pump Co., Boston.
F. W. Seaver, Chapman Valve Co., Springfield.
Randolph Brandt, Selden Patent Packing, New York.
A. H. Brodrick, Chadwick Lead Works, Boston.
William A. Brown, Deane Steam Pump Co., Holyoke.
Jesse Garrett, R. D. Wood & Co., Philadelphia.
B. Frank Poisey, Walworth Manufacturing Co., Boston.
W. J. Root, engineer for Henry P. Worthington.
W. H. Marsh, Tuerk Moter Company, New York.
John Andrews, Asbestos Packing Company, Boston.
E. P. Draper, Pattee & Draper, Holyoke.
Edward H. Rice, Walworth Manufacturing Company, Boston.
A. F. Upton, Jarvis Eng. Co., Boston, Mass.
John Cunningham, Cunningham Iron Works, Boston, Mass.
M. T. Davidson, Davidson Steam Pump Works, Brooklyn, N. Y.
John J. Langford, contractor, Boston, Mass.
B. C. Mudge, H. G. H. Taw and W.E. Welch, of H. R. Worthington Co.

The following were elected members of the convention:

Active.

William E. Nason, superintendent, Franklin, Mass.
William Ripley Nichols, professor chemistry, Mass. Inst. Tech., Boston, Mass.
W. S. Chaplin, professor engineering, Harvard University, Cambridge, Mass.
W. H. Whitcomb, president water company, Norway, Me.
Martin Coryell, engineer and superintendent, Lambertville, N. J.
Charles B. Brush, engineer, and superintendent, Hoboken, N. J.
Edward H. Phipps, hydraulic engineer and superintendent, New Haven Co., New Haven.
Robert L. Cochran, superintendent, Nahant.
Charles H. Nettleton, agent and superintendent, Birmingham, Conn.
George P. Westcott, treasurer water company, Portland, Me.
A. S. Frierson, superintendent and engineer, Columbus, Miss.
Patrick Kieran, superintendent, Fall River.
Francis A. Dewson, commissioner, Newton.
Harry C. Heermans, superintendent, Corning, N. Y.
Nathan B. Bickford, superintendent waterworks O. C. R. R., Boston.
James P. Wigal, superintendent, Henderson, Ky.
V. C. Hastings, superintendent, Concord, N. H.
John M. Diven, secretary and treasurer, Elmira, N. Y.
James Wilson, engineer, Kingston, Ca.
Edward Heywood Brown, secretary, treasrer, superintendent, Syracuse, N. Y.
William Ryle, superintendent, Patterson, N. J.
A. W. Denman, secretary and manager, Des Moines, Ia.
M. L. Holman, principal assistant engineer, St. Louis, Mo.
Stephen E. Babcock, chief engineer, Little Falls, N. Y.
Frank L. Fuller, engineer, Wellesley Hills, Mass.
David B. Kempton, commissioner, New Bedford.
Joseph E. Beals, clerk and registrar, Middleboro.
Charles F. Allen, treasurer, Hyde Park.
Walter Coburn, president, Lowell.
William Dixon, superintendent, Mt. Pleasant, Mich.
W. P. Whittemore, superintendent, North Attleboro.
William Rotch, civil engineer, Boston.
John B. Brady, commissioner, Worcester.
Charles A. Allen, city engineer, Worcester.
William Hancock, president, Trenton, N. J.
Elbridge T. Brown of Brockton, engineer, Brockton.

Associate.

W. C. McClallan, contractor, Boston.
Z E. Coffin, manufacturer supplies, Boston, Mass.
J. A. Tilden, Hersey Meter Company, So. Boston, Mass.
W. H. Foster of the Whittier Machine Co.

Honorary.

Geo. H. Frost, ENGINEERING NEWS, New York.

Members joined between January 1, 1886, and date of New Bedford Meeting.

Active.

Phinehas Ball, C. E., Worcester, Mass.
Edward W. Cate, commissioner, Newton, Mass.
Wm. M. Hawes, Fall River, Mass.
B. Frank Drake, superintendent, Lake Village, N. H.
A. G. Pease, superintendent, Spencer, Mass.
Geo. J. Ries, superintendent, East Weymouth, Mass.

Associate

Geo. H. Bishop, C. E., Middletown, Conn.
Wm. J. Root, C. E., H. R. Worthington Co., New York.
H. G. H. Taw, C. E., H. R. Worthington, New York.

Guests.

F. A. Denson, commissioner, Newton, Mass.
D. N. Sweitser, president, Lynn, Mass.
A. A. Davis, commissioner, Lynn, Mass.
A. J. Jones, superintendent, New Brunswick, N. J.
E. H. Phipps, Superintendent West Haven Water Co., New Haven, Conn.
H. Q. Sanderson, commissioner, Springfield, Mass.
F. B. Bickford, Superintendent O. C. R. R. Water Works, Boston, Mass.
George Pettie, commissioner, Newton, Mass.
Geo. A. Kimball, city engineer, Somerville, Mass.
Wm. H. Foster, Whittier Machine Co., Boston, Mass.
J. A. Tilden, Husey Meter Co., Boston, Mass.
Geo. H. Frost, ENGINEERING NEWS, New York City.
Joseph E. Watt, commissioner, Lawrence, Mass.
A. H. Smith, president; Wm. Leonard, commissioner; D. B. Gardner; Chas. Higbee, Salem, Mass.
Jas. P. Roberts, pumping engineer, Lowell, Mass.
P. I. Perris, commissioner; Henry M. Lovering, commissioner; S. D. Presbieg, commissioner, Taunton, Mass.
Robert D. S. Mortimer, commissioner; Jas. I. Murphy, commissioner, Marlboro, Mass.
Wm. Hancock, commissioner, Trenton, N. J.
Wm. Rotch, engineer, Boston, Mass.
W. W. Robertson, registrar, Fall River, Mass.
E. L. Brown, city engineer, Brockton, Mass.
Weaver Osborn, commissioner; Joseph Waters, commissioner, Fall River, Mass.
Wm. B. Smart, commissioner; Thos. F. Doherty, commissioner; Wm. Jackson, city engineer, Boston, Mass.

Naval Dry Docks.

The recent report from the Committee on Naval Affairs submitted to the House of Representatives concerning the establishing and maintaining dry docks is of especial interest. The committee states that it has been demonstrated that dry docks of wood inside, while two-thirds cheaper, are really more lasting and less costly to keep in repair than those constructed of granite. Our present docks are inefficient. We have no dock (save one not completed, at Mare Island, Cal.,) that could receive the *Chicago*. To dock this or others of our new steel cruisers would cost at a private dock not less than between five and six thousand dollars. These vessels average about 341 feet in length. The report is accompanied by two views of the stone dock at the Brooklyn Yard, showing leakage and ice formation at the head of the dock, and displaced masonry and leakage at the entrance. There is needed $125,000 to put this dock in repair.

The report contains an extract from the report (which is highly commended by the committee) of Naval Constructor Philip Hichborn, U. S. Navy, on European dock yards, etc., as follows:

In London I had the pleasure of inspecting the machinery constructed by Mr. Allen for pumping the large dock recently built at St. John's, Newfoundland, by Mr. J. E. Simpson, of New York, whose dry docks have met with great approval from the civil engineers and constructors of the United States Navy, and which have a great advantage over the graving docks of Europe in cost, light and accessibility.

There are two centrifugal pumps, having 36-inch suctions, driven directly by two horizontal engines, 21 inches in diameter and 22 inches stroke. They are intended to run at 170 revolutions with eighty pounds pressure. The combined capacity of the pumps is 6,400,000 imperial gallons in two hours.

It may be interesting to state that the total length of this dock, from the outer sill to the inside of the coping at the heads of the dock, is 610 feet 10 inches, the breadth across the top is 132 feet 6 inches, the breadth across the bottom is 49 feet 10 inches, the depth of water over the sill at spring tides is 25 feet.

Wooden docks cost from 30 to 50 per cent. less than those of stone, and in climates where they are exposed to severe frosts are much cheaper in maintenance; extensive repairs are not required within the first twenty years.

The report also contains the report of a board of officers, of which Commodore P. C. Johnson was chairman, made to ex-Secretary of the Navy Hunt in 1882, after examination of of Simpson & Co.'s docks at South Brooklyn, of the capacity, wear and cost of maintaining and operating these docks and their relative durability, which showed that all things taken into account the kind of docks at this naval station is the best in use. Now let a suitable appropriation be made to put it in good order and send along the vessels to be repaired.—*N. H. Gazette.*

CORRESPONDENCE.

The Prismoidal Formula.

POTTSVILLE, PA., June 18, 1886.

EDITOR ENGINEERING NEWS:

The discussion of the use of the Prismoidal Formula for calculating railroad earthwork seems to come up periodically, not only in the papers, but also upon the opening of new work.

The argument which determined the use of the approximate "averaging end area method" on the upper portion of the Penn. Schuylkill Valley R. R. and on the Pottsville and Mahanoy R. R. was as follows:—

1st. The necessary rapidity required in making out estimates of work done.

2nd. As results thus obtained are generally large; contractors are assured of full yardage.

3rd. The calculation of a middle area, especially on rough side hill work, is long and tedious.

4th. The actual measurement of a middle area in the field, does not generally give the true middle area of a prismoid; but rather, the end area of a prismoid one-half as long as the original.

The reason of this is evident from the fact that it seldom happens in practice, that a middle section will be found such that a straight line can be drawn through corresponding points of three cross sections; inasmuch as the variation of a few tenths in the regularity of the ground will prevent this and thus destroy the use of the section for a middle area of a prismoid.

Therefore, in conclusion, better increase cross sections taken in the field and thus multiply prismoids; rather than figure or hunt middle areas, taking the special precaution to note at the entrances of cuts, whether the first prismoid be a wedge or a pyramid and calculate accordingly.

Yours truly,

CHAS. S. CHURCHILL, P. A. Eng.

Foreign Notes.

From Herapath's Journal.

RAILWAY ENTERPRISE IN ECUADOR.—We learn that a contract has been made by an Englishman, Mr. M. J. Kelly, for the completion of a railroad to the Sierra for 82 kilometres, from the Bridge of Chimbo to a place called Sibambe, from which there are fairly good roads to the different towns of the Quito district. The Government grants to Mr. Kelly the free use of the railway already constructed from Tagnachi to Chimbo, and all the rolling stock, etc., and also the income of the railroad from the celebration of the contract to the 31st of August, 1907. The value of the work is to be paid for by the concession to the contractor of the salt monopoly from the date of one month after signing the contract until the 31st of August, 1897. This is calculated to produce about 200,000 sucres per annum. Some engineers have already commenced the tracing of the line for the extension of the railroad; bridges have been sent for to Europe for the Chimbo river, and other materials are stated to be on the road. A contract has also been made by Mr. Kelly for the connection by a short railroad of the town of Machala with Puerto Bolivar, of the same district. This road will afford a much better outlet for the large cocoa produce of that part of the Republic. The port is, by a recent law, to become an open port for commerce so soon as certain necessary and specified conditions have been complied with. The system of tramways throughout the city has been extended during the year. The Company has paid a dividend for 1885 of 12 per cent. on the capital, and has appropriated the surplus profits (nearly 12 per cent. more) to the extension of the lines.

A RAILWAY WANTED.—A correspondent, writing on the trade of San Francisco for the past year, says the country between Astoria and the interior valley of the Willamette and the general railway system in San Francisco is without a railway. A lucrative opening for capital lies in the reach of the person or company

that may open up this line, which would pass through country known to contain a rich mineral deposit of coal lying on both sides of the coast range, besides the valuable cedar forests, and some country available for settlement. This tract has, till within six months, been held by a railroad grant, the interest of the grantees being against the opening up of the line. The grant has been forfeited.

We are enabled to state that the Imperial Government have finally decided to make the Livonian railway between Riga and Pskoff, which has for many years been most urgently desired by the mercantile community as well as by the landed proprietors in the province. This railway, which is to be commenced without delay, is about 200 miles long, and will probably be completed in about two years.

Respecting the trade and commerce of San Salvador for the year 1885 we learn that in consequence of the disturbances the work of construction on the Sonsonate and Santa Ana road was entirely suspended. It has, however, since been resumed, and the road is now graded near to the village of Ateos, distant about five miles from Armenia.

Respecting the Conde D'Eu Railway in Brazil, we understand that there has been a scheme before the Imperial Government for some time for the extension of this railway to Cabedello, and touches on the immense advantages to be secured by the execution of the same.

It is generally believed that the railroad works in Costa Rica will commence very shortly, when much activity and life will spring up in all departments of commerce by the immigration of laborers, as also by visitors and capitalists seeking safe and profitable investments in commerce and agriculture.

Judgment has been delivered by the Court of Appeal in the Tilbury Docks contract dispute as far as the mode of conducting the arbitration is concerned. Messrs. Kirk and Randall undertook to excavate the new docks at Tilbury at the rate of 1s. per cubic yard. on the assumption that the subsoil was clayey. It turned out to be soft; quarrels ensued, the Company took possession of the works, and gave the contract to other hands. Eventually Sir F. Bramwell was appointed to arbitrate, and he forthwith began to take evidence as to the nature of the soil. An appeal to the Divisional Court and a final appeal to the Supreme Court of Judicature followed, with the view of restraining him from so acting. The judgment now delivered is to the effect that he is right in receiving this evidence. The claim of the contractors involves a sum of £600,000.

After an inquiry extending to two day a Select Committee of the House of Commons has decided to reject so much of the Salford Corporation Bill as sought powers to contribute £250,000 towards the capital required for the construction of the Manchester Ship Canal. The principal opponents of the Bill were the railway companies, who, as large ratepayers, naturally objected to being compelled to contribute towards a competition scheme.

The following table shows the quantities of steel rails exported to the respective countries in the five months ending with May, and in the corresponding periods of 1885 and 1884:—

To—	1884. Tons.	1885. Tons.	1886. Tons.
Russia	4,144	2,381	2,491
Sweden and Norway	20,133	3,866	6,204
Germany	222	17	19
Holland	—	7	—
Spain and Canaries	6,020	2,225	960
Italy	3,530	592	3,461
Egypt	3,654	20,727	218
United States	8,697	4,843	10,114
Mexico	2,190	408	608
Brazil	18,912	7,153	7,097
Argentine Republic	25,940	8,984	12,681
Chili	7,112	2,139	527
Peru	3,459	1,095	707
British North America	11,461	28,977	12,563
British Possessions in South Africa	6,827	5,267	1,826
British East Indies	37,812	63,588	54,621
Australasia	52,888	33,143	33,792
Other countries	23,967	17,889	12,313
Total	237,008	203,301	160,202

The increase in the case of the United States would point to a gleam of hope in that quarter. It will be noticed that Australasia keeps up well. The increase in the case of the Argentine Republic is only what might be expected considering the important extensions now being laid in that country.

WATER

CAMDEN, N. Y., is to have a system of water-works.

BROWNWOOD, TEX.—Water-works are to be built.

KEARNEY, NEB.—G. W. Frank will undertake a system of water-works.

MEXIA, TEX., has decided by vote to build water-works.

No. 20. Water Pressure in Mains of Various Cities.

COMPILED BY J. J. R. CROES. FROM SPECIAL RETURNS, JAN., 1886.

TOWN AND STATE.	Topography.	Difference of level in town. feet.	In Business District. Day Pressure. lbs.	In Business District. Night Pressure. lbs.	Fire Pressure lbs.
Minersville, Pa.	hilly.	250 to 300	85	95 to 150	——
Moline, Ill.	hilly.	135	75	60	100 to 140
Moncton, N. B.	level.	10 to 20	40	45	——
Mt. Carmel, Pa.	hilly.	——	75	75	75
Mt. Holly, N. J.	level.	15 to 20	40 to 55	40	40 to 55
Mt. Pleasant, Ia.	level.	0	35	35	80
Plainwell, Mich.	level.	10 to 25	40	40	80
Plattsburgh, N. Y.	——	50	86	86	86
Portsmouth, Ohio.	level.	——	40	40	100
Potsdam, N. Y. [Wis.	level.	20	45	45	100
Prairie d u Chien,	level.	0	20	20	25
Princeton, N. J.	hilly.	30	40	45	120
Santa Cruz, Cal.	hilly.	100	50	55	120
Santa Rosa, Cal.	level.	0	28	35	56
Sarnia, Ont.	level.	6	35	30	80 to 150
Sayre & Athens, Pa.	level.	10	80	80	120
Sherburne, N. Y.	hilly.	20	100	105	——
Sheridan, Mich.	level.	0	50	——	150
Tioga, Pa.	level.	0	90	90	90
Towanda, Pa.	hilly.	150	95	95	95
Traverse City, Mich.	rolling.	30	30 to 45	30 to 45	60
Tremont, Pa.	hilly.	35	50	50	50
Tyrone, Pa.	hilly.	60	30	40	——
Waterford, N. Y.	level.	0	80	80	150
Wausau, Wis.	hilly.	——	40	40	100 to 130

PINE BLUFF, ARK.—Water-works will be built this year. For particulars address H. King White.

RYE, N. Y.—The Port Chester Water Company will erect new water-works. J. O. Merritt, contractor.

ASHEVILLE, N. C.—A system of water-works to cost $100,000, is contemplated.

WARSAW, IND.—The pipe laying for the water-works has been completed.

COLEMAN, TEX.—The Coleman Water-Works Company, organized June 8, capital $16,000, will commence work as soon as chartered.

WATERTOWN, N. Y.—The Westchester County Water-Works Company has been incorporated. Capital stock, $100,000. John F. Moffatt and others, incorporators.

PEKIN, ILL.—The Pekin Water-Works Co. has been incorporated. Capital stock, $100,000. Chas. A. Lamb and others, incorporators.

ALPENA, MICH.—The Water-Works Company is discussing the removal of the water-works from the dam to the lake shore and putting in steam power.

HOLMESBURG, PA.—Water-works are to be erected at a cost of $40,000. Jonathan Rowland, A. C. Shallcross and J. H. Brown are interested.

THOMASVILLE, GA., will decide by vote June 30, whether or not to issue $15,000 bonds to build water-works. It is proposed to erect a tank with a capacity of 100,000 gallons on the top of a tower 70 feet high.

IDAHO SPRINGS, COL.—A test of the Deemer well water, which the Board of Health recently condemned because of its supposed impurity, has been made by a competent chemist, and it proved to be excellent water.

MONONGAHELA, PA.—A company to be known as the Monongahela City Water Company is seeking incorporation to supply the city with water. W. B. Meredith and others are interested.

THE *Northwestern Architect and Improvement Record* says that Messrs. Loweth and Curtis, of St. Paul, are preparing plans and "speculations" for a system of water-works for Black River Falls, Minn.

CHICAGO, ILL.—The Burlington Water-Works Company has been incorporated. Capital stock, $500,000. Chas. F. Coffin, 140 Washington street and others, incorporators.

ATTLEBORO', MASS.—The Water Supply District have decided to put in pumps and do their own pumping, which has heretofore been done by contract with a private party.

MINERVA, O.—After withstanding a test pressure of 200 pounds to the square inch, the water-works which were put in by the Pittsburg Water and Gas Construction Company, were accepted by the trustees. Mr. C. H. Taylor had charge of the construction for the company.

MR. WM. PAUL GERHARD, civil engineer, has been consulted about the best method of sewage disposal to be adopted for the buildings of the State Asylum for the Insane at Middletown, Conn. In his report he will recommend the adoption of a local system of utilization and purification, by sub-surface irrigation and flush-tank, on the grounds adjoining the asylum buildings.

STOCK WATER SCHEME.—The report that comes from Persia, to the effect that the Shah wants a railroad system on the American plan, indicates that the Oriental potentate has awakened to the idea that the great need of the Persian deserts is more water.—Pittsburg *Dispatch*.

TELLURIDE, COL.—The Telluride Water-Works Company, capital stock $10,000, has been incorporated. Directors—Haynes A. Corbin, Theodore A. Davis and Charles F. Painter; operations to be carried on in San Miguel county, and principal office to be at Columbia, said county.

SUMTER, S. C.—The town has authority to issue $20,000 of bonds at 6 per cent. interest, to equip a fire department and furnish a water supply. The town is now open to propositions as to style of works to supply the water. The town is three-quarters of a mile in each direction, measuring from the center, and has 3,000 inhabitants. For particulars, address Marion N. Wise.

DAWSON, GA.—At the election held on the water-works question June 11th, there was but little interest manifested in the matter and the vote polled was comparatively small. The following is the result: For, 115; against, 17; majority for water-works, 98. Over two-thirds of the votes cast being in favor of water works, the Council is empowered by the people to proceed as they see fit.

BEVERLY, MASS.—The town of Beverly, after a thorough examination of the various systems, has awarded the contract for building its water-works machinery, to the Holly Manufacturing Company, of Lockport, N. Y. The specifications call for two 2,000,000 gallon Gaskill compound pumping engines, with boilers and all appurtenances complete, capable of performing very high duty.

CHICAGO, ILL.—A permit has been issued to the Chicago Gaslight & Coke Company to construct a tunnel under the river at Taylor street in order to connect its South Side mains with pipes to be laid on the West Side. The tunnel is to be large enough for a 35-inch gas main and a 24-inch water-pipe, and is to cost about $50,000. The work is to be done under the supervision of the City Engineer.

PHILADELPHIA, PA.—At the meeting of the Water Committee on June 15, Mr. Holman, of the Twenty-fifth Ward submitted a report from Chief Engineer Ogden on the matter of a better water supply for Bridesburg, estimated to cost $49,500, which was received and referred to the Chief, with power to act. Proposals for building five steel boilers at Spring Garden and two at Roxborough, and for erecting pumping engines of 10,000,000 and 20,000,000 gallons capacity, were read and scheduled.

DELAWARE, O., WATER-WORKS.—F. P. Vergon has submitted to the Council the terms upon which he will grant the city the privilege of drawing its water supply from Greenwood lake. The city to build and maintain the works recommended by the engineer, Mr. J. D. Cook, to comply with certain requirements, and to pay a rental of $1,500 per annum. John Cowgill has made a proposition to the Council to convey to the city land on and including Slate Run for building the dam and forming a reservoir, and to erect all necessary build-

ings for $2,000; as an alternative he proposes to build and maintain the dam in connection with the foregoing proposition for $4,500. He will reserve the right to use the reservoir for any purpose which will not contaminate the water or interfere with the water-works.

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

The Denver and Rio Grande Railroad will be sold at auction at Denver, Col., on July 12, at the instance of Charles F. Woehrishoffer and others.

The Northern Construction Company has been incorporated in Minnesota to construct railroads and other works. The main office will be at St. Paul.

A West Virginia R ilroad.—The charter has been obtained for a line from Lexington, Va., to Brownstown where it will connect with the Pittsburg, Virginia & Charleston R. R. The distance is 150 miles; a survey has been made and the engineer's estimate of cost is an average of $35,000 per mile.

The Milwaukee & Northern Railroad is being extended from Menominee, Mich., to Iron Mountain. From Iron Mountain to Republic, a distance of about forty miles, a survey has been made for an extension of the line, which will finally be extended through Republic to Marquette.

Denver Railroad and Land Company.—Five hundred men are constructing a railroad from Denver, Col., to the coal fields of the company, 16 miles east of the city. The roads is on the 3-feet gauge. City Engineer Lowrie is Chief Engineer, and Joseph Williams has the grading contract. The offi ers of the company are: President, Captain Anderson; Vice-President, Assyria Hall; Secretary, G. W. Edwards, Chicago.

The Aspen & Western Railroad Company has been incorporated in Colorado by R. D. Thompson, Robt. Collier, and J. M. Curry, of Denver. Capital stock, $1,000,000. The line will run from Aspen to Glenwood Springs and thence down the valley of the Grand river to the Colorado and Utah boundary, with a number of branches up the valleys of several creeks.

The Little Rock & Choctaw Railroad Company was organized at Little Rock, Ark., some four or five years ago to construct a railroad through the coal-fields of Western Arkansas to McAllister, I. T., thence finally to Albuquerque, N. M. The financial trouble—the failure of Pennsylvania banks where capital was to be received—caused the enterprise to collapse, but it is now proposed to revive the scheme, and an engineer is already looking over the route.

Montreal and Sorel R. R.—As the Dominion Government has failed to include this among the subsidized roads, there is a possibility of the road being closed unless the Government reconsiders its decision. This proceeding would be a great injury to farmers along the line. It is said that an exposé of the manner in which the Company is alleged to have been deprived of the subsidy by means of political intrigues will be laid before the House by the leader of the Opposition.

The Ohio & Northwestern R. R. Co. has bid for the Cincinnati & Eastern R. R. provided terms can be made with the holders of receivers certificates. The company will undertake within thirty days of acquirement of the title to commence the work of widening the road-bed, reducing t e grades and laying a fifty-six pound steel rail between Portsmouth and the junction with such standard gauge road as may give entrance into Cincinnati, and within twelve months to complete its entire line to such junction.

Erie Canal.—The Governor has signed the bill appropriating $200,000 for doubling the capacity of a portion of the locks on the Erie and Oswego canals. The approval of this bill commits the State definitely to the enlargement of the canals. The extension of the locks now provided for will not be of material use to navigation unless the entire lock system of the canals is made to conform to the improvement. While it follows that the State by this act is committed to the improvement of the canals without federal aid, it is likely that next year the Legislature will ask Congress for assistance.

The Long Island Elevated R. R. Co. has been incorporated and opened its subscription books last Saturday; all the stock was taken by twenty-nine gentlemen, and is equally divided between the Long Island and the Atlantic avenue railroads. The route will be on Atlantic avenue, Brooklyn, and the company has applied to the City Council for power to construct its road. This is the result of the Sixth Rapid Transit Commission. The following officers have been elected: President, Austin Corbin: Vice President, William Richardson; Treasurer, Newberry H. Frost; Secretary Henry W. Maxwell. The temporary offices will be at the corner of Third and Atlantic avenues, Brooklyn.

Mississippi River Improvements.—A letter from General Gilmore, Chief of Engineers, was sent to the Senate recently, in which he says the provision appropriating $2,250,000 for the improvement of the Mississippi river below Cairo is left in a most awkward and impracticable shape; that it is neither desirable nor expedient that the plan of the commission should be further tested as the House bill directs, as the plan has been tested already with amply successful results. The letter requests that the duties of the commission be more specifically stated, and General Gilmore takes occasion to declare it to be inevitab e that the effect of a new outlet will be to reduce the velocity of the stream below it, resulting in shoaling and in ultimate disaster to the regions above. He refers to the Lake Borgne outlet scheme as visionary, and does not believe any respectable hydraulic engineer can be found who will advocate it.

West African Railroads.—The Portuguese will be the first to build a railroad in West Africa. Only about fifteen miles of the French line in Senegal have been completed, and King Leopold's Congo river scheme is hanging fire apparently for financial reasons. The Trans-African Railroad Company, on the other hand has $5,000,000 of capital to start with, the Portuguese government guaranteed the payment of interest on its bonds, its route has been surveyed for 250 miles from Loanda on the coast, and the track laying is about to begin. This road, which it is intended ultimately to extend to the large Quango tributary to the Congo, about 400 miles from the coast, will run through the heart of Angola. If it does not succeed, the prospects are very gloomy for any other West African railroad, for the country it is to penetrate is the pick of the West coast, populous, fertile and comparatively healthful.—Savannah *Morning News*.

Contracting.

Street Paving.—Broadway, Brooklyn will be paved with granite blocks. $62,000 will be spent on the work.

Cross Ties.—The Union Pacific R. R. Co. will receive proposals for 300,000 hard wood and 700,000 soft wood ties to be delivered at different points, until August 2.

Grading.—The following bids have been received at Minneapolis: A. J. Dolan, 19 cents per cubic yard; Thomas Daley, 16; W. T. Bowen, 15; Roche & Wilson, 15.

Light Keeper's Dwelling.—The lowest bidder for keeper's dwelling at Elba Island Range Lights, Ga., Was Mr. Colin McK. Grant, Charleston, S. C., his bid being $3,500.

Iron Bridge.—The contract for building an iron bridge over the Zumbro river at Millville, Minn., was awarded to Horace E. Horton of Rochester, Minn., the price being $4,000.

Tybee Railroad.—D. G. Purse, Savannah, Ga., has the contract for the Savannah & Tybee R. R. The road will be of standard gauge, laid with 50-pound rails, and is to be completed by April 1, 1887.

Burlington, Cedar Rapids & Northern R. R.—The contract for the extension from Ellsworth, Minn., to Sioux Falls, Dak., a distance of 41 miles, has been let to Vincent & Co., St. Paul, who will have the line finished by the fall.

Weir.—Superintendent of Public Works, Shanahan has awarded the contract for building the waste weir at Eagle Harbor, as provided by special act, to T. B. Smith, of Rochester, N. Y., for $3,715.10; J. M. Taylor, of Auburn, N. Y., was the only other bidder at $3,806.

Laying Pipe.—The Water Commissioners of Ware, Mass., have awarded the contract for digging the trenches and laying the 600 tons of pipe for the new system of water-works to John Longford, of Newton, who will commence work immediately.

Sewer and Pipe Laying.—The contract for the Ashland avenue sewer, Lake, Ill., has been awarded to Michael O'Brien at $39,767.98. The City Clerk has been instructed to advertise for proposals for laying water-pipe.

Boston Sewers.—The board as follows: Order for a loan of $500,000 to be appropriated for sewers; viz.: Ashmont district, $100,000; between Crescent avenue and Greenwich steeet, $40,000; Dorchester, $45,000; Beacon street, etc., $25,000: Brighton, $50,000: West Roxbury, $25,000; East Boston, $50,000: South Boston, $50,000; city proper, $60,000; Roxbury, $50,000: Charlestown $5,000.

Pennsylvania Railroad.—Sealed proposals for completing the grading and masonry for tracks Nos. 1 and 4 between Devon and Berwyn, on the Philadelphia Division, about one and a quarter miles will be received by the Chief Engineer, Philadelphia until July 3. Bidders must personally examine the ground. Plans and specifications may be seen at the office of the Assistant Engineer, Broad Street Station, Philadelphia.

Brick Paving.—We think the Jacksonville plan the best, putting down a bed of cinders first which makes a cushion and furnishes drainage far the water; then sand and the two courses of brick. Our pavement costs about $1.55 per square yard, exclusive of digging. The Springfield cedar blocks cost $1.35, and compared with our improvements are a mere make shift which will be rotten or full of holes while our own will be in good condition.—Jekasonville, Ill., *Journal*.

A Bridge Squabble.—At Eatontown, N. J., a new bridge was to be built over the mill stream on a private road, the owner giving right of way if an iron bridge is built. The Freeholders agreed to erect a wooden bridge which the road proprietor would not accept, but said he would compromise on a stone arch. There the matter rests until the next meeting of the Board on July 14.

New York State Canals.—James Shanahan, Superintendent of Public Works, will receive proposals at his office in Albany, until July 15, for enlarging canal locks at Syracuse. Plans, maps, specifications, etc., may be seen for five days prior to the day of letting at the above office and at the office of the Division Engineer, Syracuse, N. Y. Full particulars were published in the Albany *Journal* June, 22, and will be published in that paper on Tuesday and Fridays till date of letting.

Bridge.—The bids for the High street bridge, Springfield, O., were as follows:

Superstructure—Smith Bridge Co., $10,000 and $12,000; Lomas Forge and Bridge Co., $9,600 and $11,150; Champion Bridge Co., $9,850; Penn Bridge Co., $9,900; Canton Bridge Co., $9,000; Mt. Vernon Bridge Co., $9,650; King Bridge Co., $9,705.50; Columbia Bridge Co., $9,776.

Masonry—Andrew Burnett, $19,900; Joseph Bolan, $18,000; Fish & Crist, $23,000; D. F. Minnehan, $17,980; Enos Hege, $17,700. The last three were not formal in some respects.

Bids were also received for arch at Penn street: Joseph Bolan, $840; Wm. Scholls, $613.80.

Sewers and Paving.—Bids for the construction of public sewers on Lincoln avenue and John R. streets, 1,275 and 1,068 feet long respectively, and for paving Farnsworth street, were opened recently by the Detroit Board of Public Works. Frings & Steinheuser were award the sewer contracts, their bids of $2.50 per lineal foot for the work on Lincoln avenue, and $1.14 per foot for the John R. street sewer being the lowest. The paving bids, of which there were half a dozen, were the closest known for years, there being only a few dollars difference between the largest and the lowest. Ledbeter & Stewart secured the contract on bids aggregating $9,599.52.

Pumping Engines.—Proposals for high service pumping engines will be received at the office of the Water Board, City Hall, Boston, Mass., until July 29th. Each proposal must be accompanied by detailed description and specifications of the engines proposed to be furnished, and also drawings showing the general design and dimensions of the same, and of the engine foundations. In canvassing the bids received, the cost of the foundations required will be estimated by the city engineer and added to the price proposed for the engines. General specifications and form of contract can be obtained at the office of the City Engineer, and the attention of bidders is called to the general specifications and forms of contract under which the engines are to be furnished.

Steel Rails.—The Pittsburg mills are keeping up to their share of the regular output. The Union Pacific R. R. Co. besides a large amount of rails which is already consigned to it, is asking for bids on 10,000 tons more. With this the management intend to keep on with the work of replacing the iron rails laid when the road was built.

The Chicago, Milwaukee & St. Paul Railroad Co. is also asking for bids for 15,000 tons of steel rails. They are to be used in building the Kansas City branch of that line. At present the road connects only with northern and northwestern points. The new branch is to be built from Ottumwa, Ia., southwest to Kansas City, a distance of about 100 miles.

Water Works Machinery.—The Philadelphia Water Committee of Councils has awarded the contract for 4-inch stop-valves to the Southwark Foundry and Machine Co., and for five boilers at the Spring Garden pumping station and two at the Roxborough pumping station, to J. P. Morris & Co. Chief Engineer Ogden recommended that an award be made for one 20,000,000-gallon engine, the selection of which be hereafter determined, so that the committee may have a chance to examine the various kinds of engines before any award is made. The bids as received are as follows; Wharton & Maxwell Company, $85,000; William Cramp & Son, $72,330; Holly Manufacturing Company, $60,000; Robert Wetherill & Co., $67,000; H. R. Worthington & Co., $67,000. Representatives of the various firms were heard but no action taken by the committee in regard to this question. The committee will inspect in person the various systems.

Review of the Iron and Steel Markets.

Specially Prepared for ENGINEERING NEWS.

After the long continued depression at home and abroad, particular attention is being paid to the iron markets; for their course, as is well known, is almost an unfailing index to the general situation. Although reports may, according to districts, seem contradictory, there is no doubt that a very decided improvement has taken place in most branches of the iron business. Had it not been for the influence of the strikes, this change would have been decidedly more marked. The ever increasing population and the opening up of new lands in our vast continent, which factors have steadily gone on during these years of depression, are now beginning to tell even if railroad building has been overdone. Still many sections have grown up to their rail accommodations, and new communities have come to the front—clamoring for railroads, water-works and all the material requirements of American civilization. Of course, our markets are very cautious about advancing prices in view of the longing eyes that English makers are casting in our direction. Projects of new roads are cropping up every day, and some rough guesses as to the amount of road to be built, are already being made.

PIG IRON.—Orders for American have been somewhat more numerous, and prices, with the exception of Southern forge, are firmly maintained. We quote American No. 1 at $18, and No. 2 at $17. Iron certificates were $15.25 to $17, and June delivery at 316.12½.

Scotch of all brands was steady, but only small lots were disposed of.

Glengarnock was quoted $18.50 to $18.75; Eglington, $17.50 to $17.75; Gartsherrie; $19. Summerlee, $19.25.

Reports from Philadelphia state that the saleableness of iron depends a great deal on its quality, that large consumers are watching the turn of events very carefully and that an improvement is looked forward to within the next thirty or sixty days.

STEEL RAILS.—Some 10,000 tons were lately sold at $34 to $35, and Eastern mills are well supplied with orders.

In *old material* there has been a better feeling in the Philadelphia market; sales of old rails have been made at from $20 to $20.50 at mills, and duplicates would be hard to fill.

Foreign Rails are quoted $37 to $37.50. There is some speculation reported in foreign and American old.

Iron and Steel for *Building* has also somewhat improved, owing to demand for large new structures. Angles are quoted 2c. to 2.10c. and Tees 2.40c. to 2.45c.

In *Spiegeleisen* very little has been done, nominal quotations are $25 for 25 per cent. and $21 for 10 to 12 per cent. A letter from Pittsburg says, "The railway supply trade is a good one; this includes car axles, nuts, bolts and specialties, and 200 tons of these are made daily. The pipe mills are turning out 580 tons a day and refusing to take orders."

In *Plates* the market has been very quiet, and there has been some cutting of prices. Common or tank ruled from 2.12c. to 2.20c. in the New York Market Flange 3.4c. to 3.5c.

In *Lead* there has been very little change of late; quotations for pig were 4.80c. for common and 4.85c. for refined.

No great changes are reported in the *copper* quotations, but the recent heavy sales by the Calumet and Hecla Company, has eased and strengthened the market. Lake is firm at 10c., others are at 9¾c. Chili bars are £40 2s 6d.

Trade abroad shows some slight improvement in some lines, but the general situation remains unchanged. The exports of English pig during the five months, show a slight increase over those in 1885, mainly due to the increase in shipment to this country, which rose from 42,264 to 118,017 tons. Of railroad iron 18,484 tons were exported to the United States. The elections will seriously interfere with home trade for some time. The shipments of Scotch pig iron have been good, but there has been a decided restriction in production. Canada has been taking fair quantities, and heavy cargoes have been lately sent from the Tyne to New York and Baltimore. The exports of *railroad iron* of all sorts, from Great Britain during the five months are interesting, as showing the countries where most building is going on (excepting the United States.) We find the Argentine Republic took 32,819 tons; British India 129,061; Australia 43,056, the United States 10,484 tons. The total exports of iron and steel to the United States amounted to 295,066 tons, India came next with 195,252. In fact there has been a fair increase in the May exports and a more hopeful feeling is prevailing. The "boom" this time, as previously, is coming, or expected to come, from the United States.

The reports from the Rhenish iron districts in Germany are fair, but the production of pig iron iron has fallen off 200,000 tons during the year. Spiegel and foundry iron are neglected, while Thomas and Bessemer are in demand.

Both the French and Belgian iron masters have formed syndicates, and heavy fines are imposed for breach of agreement.

TRADE NOTES.

(Twenty cents per line per insertion.)

THE CLAYTON AIR COMPRESSOR WORKS, Brooklyn, N. Y., have just received an order for a large Duplex Air Compressor. The steam cylinders are each 12 in. stroke 26 in. and air cylinders 8 in. This machine is capable of taking in 600 feet of gas per minute. It will take about eight weeks to complete the order. The machine will be set up, and put in running order at the works, and satisfactorily tested before shipment, which will be to Sydney, Australia, through the commission house of W. H. Crossman & Bro. of New York, it being the second of this class of machines ordered by this firm for the same parties. A good endorsement of Mr. Clayton's workmanship. It is only recently, that our American Manufacturers have been able to compete with the English makers for this class of heavy machinery.

MISSISSIPPI JETTIES.

34 NASSAU STREET, NEW YORK, May 19, 1886.

MESSRS. JOHNSON & WILSON:

GENTLEMEN:—I have your note of April 23d, 1886, with inquiries concerning the condition of the Concrete blocks at the mouth of the Mississippi, made with your "Saylor's Portland Cement", in 1875-79.

I am glad to inform you that these blocks show no signs of deterioration whatever, their edges and angles being still sharp and perfect. One mile of these blocks with a parapet built over them continuously were placed on the East Jetty, and a one-half mile of similar blocks were placed on the West Jetty at the sea ends o each. A portion of the parapet and blocks on the East Jetty were injured by a severe hurricane about a year or two after they were built, but this result was not caused by any inferiority of the Cement or Concrete.

I consider it the best Cement which I have ever used.

Very truly Yours,

JAS. B. EADS.

Market Report of Engineering Materials.

New York June 24, 1886.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles	2.00c	@	2.10c
" steel	2.35	@	2.45
Tees	2.40	@	2.45
Beams and channels, American	3.6	@	
Tank plates	2.13	@	2.20
Shell plates	2.4	@	2.5
Steel plates, Tank	2.70	@	2.75
WROUGHT-IRON PIPE. PITTSBURG.			
Butt welded, black ..... Discount			45
" " galvanized ..... "			35
Lap welded, black ..... "			60
" galvanized ..... "			42½
Boiler tubes			52½
RAILS.			
Steel (large lots at mill)	$34.00	@	$35.00
Old rails	18.50	@	19.00
Old rails, steel	22.00	@	23.00
R R. spikes			2.40c
R R. splice-plates	1.80	@	2.00
R R. track bolts, square nuts	3.00		
Barb-wire fencing, galvanized	4.38		
" painted			4.00
Corrugated iron			
Nails			
Iron, per keg	2.00	@	2.10
Steel do.	2.55	@	2.60

METALS.

COPPER.			
Lake Superior	9.95	@	10.20
Other Brands	9.50	@	9.70
LEAD.			
Com. Domestic	4.80	@	4.85
Lead Pipe	.06¾c.		
Tin-Lined Lead Pipe	.15		
Sheet Lead	.07¼		
ZINC.			
Sheet	$5.50	@	5.70

BRICK.

Cargoes (afloat)			
Choice Brands	7.75		
Haverstraw ..... per M.	7.25	@	7.50
Fishkill	7.25		
Up-River	6.75	@	7.00
Jerseys	5.50	@	6.25
Long Island	7.00	@	7.25
Pale	4.50	@	5.00
FRONTS.			
Croton, red	11.00	@	15.00
" dark	11.00	@	15.00
" brown	10.00	@	14.00
Philadelphia pressed	24.00	@	28.00
Trenton "	24.00	@	26.00
Baltimore "	37.00	@	41.00
Buff "	33.00	@	35.00
Enameled English	85.00	@	130.00
" American	80.00	@	120.00
Fire brick	25.00	@	55.00
" American, No. 1	30.00	@	35.00
" " No. 2	25.00	@	30.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

CALVIN TOMKINS:			
"Old Newark Co's." Cement			$1.10
BAETJER & MEYERSTEIN:			
Hanover Port.and	$2.60	@	$2.65
BELLONI & Co.:			
Hemmoor "Crown" brand			2.50
JAMES BRAND:			
K. B. & S.	2.55	@	3.00
BROOKS, SHOOBRIDGE & Co.	2.45	@	2.60
HOWARD FLEMING:			
Gibbs' English Portland, 400 lbs.	2.50	@	2.75
" K. B. & S.	2.25	@	2.50
Stettiner, German	2.65	@	2.85
Lagerdorfer, "	2.45	@	2.75
Fleve, A 1, Belgian	2.35	@	2.50
Roman	2.75	@	3.00
Keene's Coarse	4.75	@	5.50
" Fine	7.75	@	8.50
" Superfine	8.50	@	10.00
FISHER, ERSKINE W.:			
Stettin (German) Portland Cement	$2.40	@	2.75
GABRIEL & SCHALL:			
Vorwohler "Lion"	2.65	@	3.10
HUDSON RIVER CEMENT Co. Rosendale			0
JOHNSON & WILSON:			
Saylor's American Portland	2.15	@	2.45
LESLEY & TRINKLE, Philadelphia, Pa.:			
"Giant" Portland	2.20	@	2.40
Improved "Union"	1.25	@	1.50
Union	1.10	@	1.20
MARCIAL & Co.:			
J. B. White & Bros. Coarse Keene's	4.25	@	4.50
" " Superfine	7.25	@	7.50
" " Portland	2.45	@	2.85
NEW YORK CEMENT Co.:			
Rosendale			1.10
N. Y. & ROSENDALE CEMENT Co.:			
Rosendale, "Bridge" brand			1.10
SINCLAIR & BAUSON:			
Alsen's Portland Cement Works	2.35	@	2.85
K. B. & S.	2.25	@	2.50
STANDARD CEMENT Co			
E. THIELE:			
Dyckerhoff	2.90	@	3.25
UNITED STATES CEMENT Co.:			
English Portland	2.25	@	2.40
German "	2.00	@	2.15
Standard	1.50	@	1.65
Windsor and Improved Rosendale	1.00	@	1.10
UNION AKRON CEMENT Co.:			
Akron "Star" brand	1.00	@	1.10

ASPHALT.

ROCK.			
Prices range per ton	$15.00	@	20.00
According to quantity or brand, and whether taken from vessel or store.			
PAVEMENT.			
Barber's Asphalt	$2.50	@	$3.

LIME.

Rockland, common per bbl	1.00		
" finishing	1.20		
State, common	.80	@	.90
" finishing	1.10		
Kingston, ground	.90	@	1.00
Add 25c. to above figures for yard rates.			

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.95	@	1.00
" " No. 2 "	0.75	@	0.85
" " light drab "	0.80	@	0.95
Berlin " in rough "	0.75	@	1.00
Berea " "			
Brown stone, Portland, Ct. "	1.00	@	1.35
" Belleville, N. J. "	0.75	@	1.35
Granite, rough	0.45	@	1.25
Common building stone per load	2.00	@	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@	3.00
Concrete and macadam stone, Tomkins Cove, per cub. yd			$1.65

SLATE.

Purple roofing per square	6.00	@	7.00
Green "	6.00	@	7.00
Red "	15.00		
Black Penna. (at New York) "	4.50	@	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@	20.00
" Choice "	65.00	@	70.00
Tally plank, 1¼ in. 10 in. dres'd. each.	.44	@	.50
" boards, dressed com. "	.28	@	.30
SPRUCE, Boards dressed "	.25	@	.28
Plank, 1¼ in "	.28	@	.30
" 2 in. "	.38	@	.40
" 2 in. dressed "	.43	@	.45
Timber per M.	13.00	@	16.00
HEMLOCK, Boards each.	.18	@	.20
Joist, 2¼ × 4 to 4 × 6 in	.16	@	.44
OAK per M.	58.00	@	65.00
CYPRESS 1, 1¼, 2 and 2¼ in "	35.00	@	40.00
YELLOW PINE, Girders "	25.00	@	30.00
" Dressed flooring "	28.00	@	35.00
SHINGLES, Extra shaved pine, 16in. "			
" sawed 18 in. "	5.75	@	6.00
LATH, Cargo rate "	2.25	@	2.30

PAINT.

Lead, white, American dry per lb	.04¾	@	.06½
" " " in oil pure "	.07	@	.07½
" English, B. B. in oil "	.08¾	@	.08¾
" Red, American "			.06½
Litharge "	05½	@	.06
Venetian red, American "	.01	@	.01¼
Indian red "	.08	@	.10
Vermillion, American lead "	.10½	@	.11½
Paris green "	.15	@	.18
Umber, Amer. raw and powdered per lb.	.01½	@	.01¾
Drop black, Amer. "	.07	@	.13
" " Eng. "	.11	@	.13
Chrome green "	.10	@	.25
Oxide zinc, American "	.03¾	@	.03¾
" French "	.06½	@	.07¾